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UNITED STATES NAVAL INSTITUTE PROCEEDINGS

VOL. NO 52, NO. 11 NOVEMBER, 1926 WHOLE NO. 285

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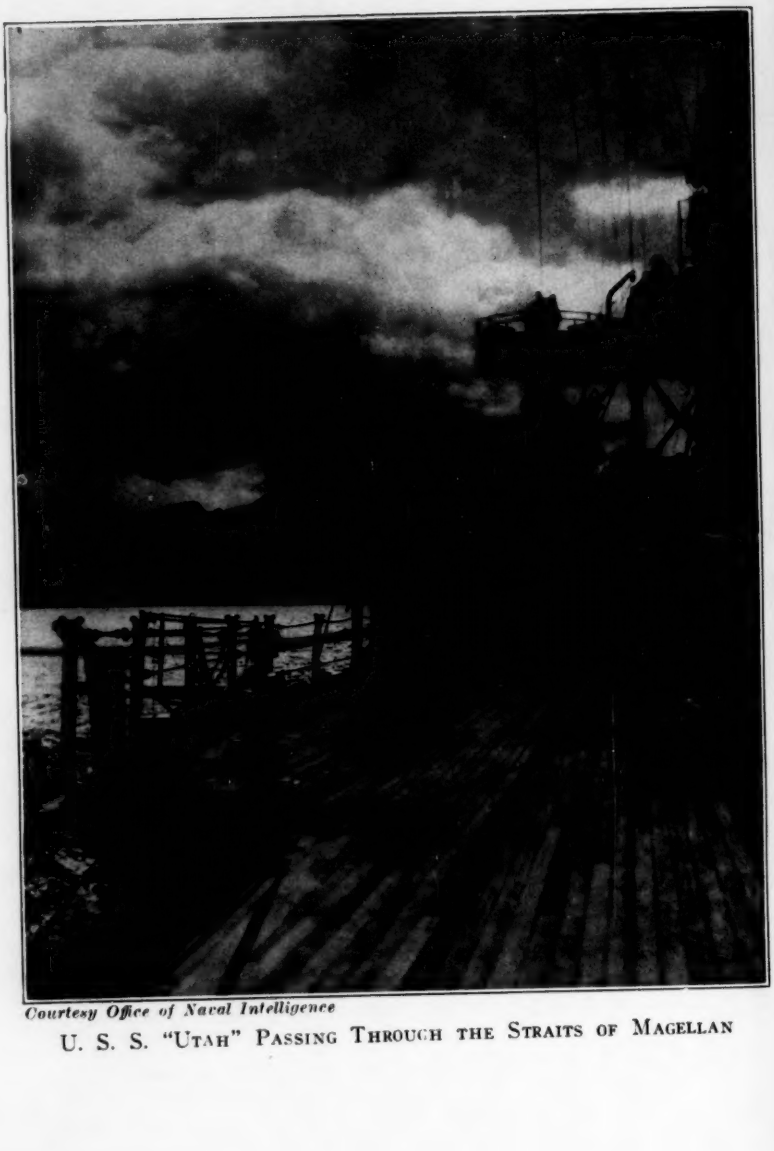

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UNITED STATES
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PROCEEDINGS

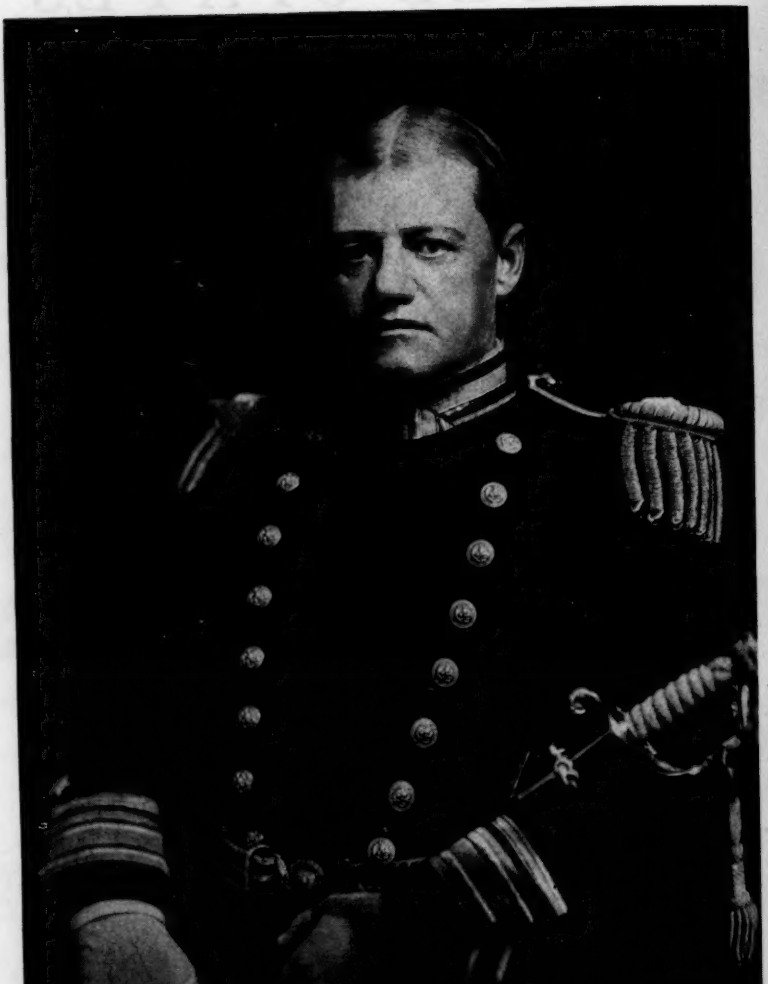
VOL. NO. 52, NO. 11 NOVEMBER, 1926 WHOLE NO. 285

REAR ADMIRAL ROBLEY DUNGLISON EVANS, U. S. NAVY
"Fighting Bob"

BY WILLARD C. TYLER

REAR ADMIRAL ROBLEY D. EVANS was probably better known throughout the world than any other American naval officer since the days of Farragut. He was one of those men who once met, could never be forgotten; and he possessed many traits of character which set him high in the esteem not only of the public, but of the important men and officers of many nations with whom he came in contact during his forty-eight years of service.

The writer esteemed it both a privilege and an honor to know him as a friend for many years, and also to have the pleasant recollection of meeting him in several parts of the world. His undaunted courage which shone out of his face, his courtesy where courtesy was required, his directness of language where the occasion demanded it, his innate honesty and his outspoken contempt for hollowness and hypocrisy, and his open condemnation of fraud and fake of every kind, appealed strongly to the real men of this nation. For a man who had spent so much of his life at sea, he possessed a broad intelligence and a grasp of the world problems of his time, seldom equalled by one of his profession. The writer is of the opinion that a brief résumé of of his long career cannot fail to be of interest to the readers of the PROCEEDINGS, and an inspiration to the younger officers of the service in these crowded professional days, when there is so little time for reading history.



REAR ADMIRAL ROBLEY D. EVANS, U. S. N.
From a Photograph in the Navy Department Library

Robley D. Evans entered Annapolis September 15, 1860, at the age of fourteen, from the then territory of Utah. He was born in Floyd County, Virginia (among its mountains), August 18, 1846, the son of a poor country doctor who practiced over thirty square miles on horseback. He was one of four children and when but ten years old, his father died of exposure. The next year he went to live with an uncle at Washington where he received two years of such schooling as the city then afforded. Curiously, he spent much of his spare time down by the Potomac watching the vessels moving about and longing for a sight of the sea, on which he was to spend so much of his life.

He had about decided to run away and join some ship when he became acquainted with a Mr. Hooper, then territorial delegate to Congress from Utah, who was a friend of his uncle. This gentleman one day asked him if he would not like to go to Annapolis and become a naval officer? His affirmative reply was so prompt and emphatic that Hooper said, "If you will go out to Utah and acquire a residence, I will appoint you," which offer was at once accepted. Going to Utah in those days was a great deal easier said than done. It meant going as far as St. Joseph, Missouri, to the railhead and traveling another thousand miles by horseback or prairie schooner, through lands more or less infested by hostile Indians. But this did not daunt the lad of thirteen who saw in it the only means to a desired end. So he set out from St. Joseph with a dozen or two men and some families who were making the trip as settlers in that region. They were well armed and that was all that saved them for they had several fights with redskins on their journey, and our boy shot several of the attacking Indians thus receiving his first baptism of fire. There he also received his first wound by having an arrow pass through the tendon of his left leg.

No one who ever studied the face of Robley D. Evans would have any doubts of either of two traits. One was his indomitable courage, and the other the quickness of his temper when emergency called for it. Someone wrote years ago that, "the boy was father of the man," and so it proved in this case. He had not been long in Salt Lake City when sitting one day on the veranda of the Hooper house reading, an arrow flew by his ear and stuck in the weather-boarding of the house back of him. Then a second one caught him in the shin bone. Looking out between the

shrubbery he discovered a Digger Indian laughing at him. Now no one regards being hit in the shin as a laughing matter, and young Evans didn't. Rushing into the house he found a loaded double barreled shot gun standing in a corner. Grabbing this, he ran out and emptied both barrels into the back of the fleeing Digger. He says, in *A Sailor's Log,* that "The Indian must have laughed out of the other corner of his mouth, while a doctor spent several hours digging shot out of his back."

His career at Annapolis was short owing to the coming of the Civil War, but he always paid high tribute to the good advice and influence exerted on him by Lieutenants C. R. P. Rodgers and George Rodgers, the former then in command of midshipmen and the latter of the old *Constitution,* the station ship of the academy. When the crisis came and the cadets were obliged to choose which side they would follow, nearly all of them went with their native states (North or South). Much pressure was brought to bear on this boy of fifteen by both his family and friends, to persuade him to go over to the Southern side with his native Virginia, but of no avail. He decided to stand by the old flag and when the remnant of the Naval Academy was transferred, with the *Constitution,* to Newport, Rhode Island, he remained with it. His mother even went so far as to send his resignation to the Navy Department at Washington, where it was accepted. When the young man heard of this he became furious and with the help of C. R. P. Rodgers, succeeding in having the resignation cancelled and in being reinstated. So near did a life-long naval career of great brilliancy come to being wrecked.

On October 1, 1863, at the age of seventeen, he was commissioned as acting ensign and ordered to the *Powhatan,* then part of a flying squadron hunting blockade runners in the West Indies. He was evidently unfortunate in his first naval captain for he says of him in *A Sailor's Log,* "He could be disagreeable in more different ways than any man who ever wore a naval uniform."

His ship was ordered to join the fleet assembling off Fort Fisher, North Carolina, in December, 1863, and he witnessed the first futile attack on that stronghold. This was chiefly bombardment from the ships and, owing to the sandy nature of the walls of the fort, did but little damage.

The second attack, with the army under General Terry cooperating, took place on January 15, 1864, and this young ensign

of only eighteen years was ordered to lead a company of marines forming part of a frontal attack on the sea walls of the fort. The men landed from the fleet and reached the outworks before the Army was quite near enough to engage the garrison on the land side. The result was that all of its defenders came to oppose them for a time with rather dreadful results. In consequence the sailors were shot down by the hundreds and young Evans was first slightly wounded in the breast but this did not stop him. Next he received a bullet in his left leg and soon after another through his right knee. Then he had a toe shot off, making four wounds in all. Of course he could not keep on so he dug himself a hole in the sand. He had not been long there when he discovered that someone was making a target of him, as bullets kept coming close enough to throw sand on him. He dug a little deeper and then began to watch carefully for this new enemy who seemed bent on his destruction. He soon located him in another hole under the parapet of the fort and by a lucky shot from his revolver, put him out of existence. How many boys of his age, wounded in four places, would have had the nerve to accomplish this?

He was finally rescued and got on board ship, being taken to a naval hospital at Norfolk, Virginia. During this time the overworked surgeons could give him but little attention. As he was put into a bed at the hospital he slipped his revolver under his pillow, with what motive will presently appear. Two doctors came to his room and the chief said to his assistant, "You come in the morning and take off both his legs." Evans heard this and reflected during the night that he owned the legs and that they were of more use to him than to anyone else.

In the morning the assistant surgeon entered his room, saying: "Now, my poor young man, I shall have to take off both your legs," undoing a case of instruments as he spoke. Whereat this young and grievously wounded ensign, pulling his revolver from under his pillow, said; "If you come one step nearer this bed I will kill you." The result was that no doctor entered his room for several days. Then he was sent to a hospital at Philadelphia together with the only other six surviving members of the gallant company he had led at Fort Fisher. At Philadelphia he received more intelligent treatment and his legs were saved. When his wounds healed he was unable to get his right foot to the ground

but had to go about on crutches. This did not suit him so he had that knee broken again and reset, so that his right leg was of some use to him. But he was left with a limp which went with him through life.

He was then invalided out of the service on account of his wounds, the only naval officer so treated, but his fighting propensity got into action again and by an appeal to Congress he was reinstated. Thus the Navy came again within a hair's breadth of losing one of its most efficient officers. Of course a naval hero cannot be developed without a war. But how many of our young officers have ever had so much experience by the time they were nineteen? I have given this much space to his Fort Fisher experience, because it developed so much real grit inherent in this very young ensign that for the rest of his life he never feared anything on earth. He knew that nothing which might come later could possibly be worse than what he had already gone through. Here we have a young naval officer who was wounded six times before he reached nineteen years of age, twice with arrows and four times with bullets, who still loved the service and insisted on remaining in it for life.

After the close of that conflict young Evans went on a long cruise to China in the *Piscataqua* and was promoted to lieutenant commander in 1868. Then he was ordered to the Mediterranean and later in 1872 sailed for the west coast of Africa in the *Shenandoah,* still seeing the world at early age.

In 1871 he had married Charlotte Taylor, daughter of Mr. Franck Taylor and sister of a classmate, Henry C. Taylor, who later became an admiral in our Navy. Taylor commanded the *Indiana* while Evans was in command of the *Iowa,* at the naval battle off Santiago.

In 1876 Evans perfected a long-distance signal lamp which was much used in our service. Later he was four years in the old training sloop *Saratoga* and took a great interest in making men out of an incongruous lot of city school boys, "suffering and useless from mental overtraining." During this period he was several times in Gibraltar, meeting many distinguished British officers and members of the nobility on whom he always made a most favorable impression. Among these were Lord and Lady Napier with whom he became firm friends.

In 1882 he was equipment officer at Washington and had a decided influence on the advisory board under Secretary Hunt, which determined that all future vessels for our Navy must be constructed of steel.

Admiral Evans even then was a man of wide information and he became an expert on steel making, especially plates. He could talk locomotives and many mechanical subjects as well as he could ships. I discussed many such subjects with him and never found him at a loss for intelligent comment. In 1884 he became lighthouse inspector, fifth district, with headquarters at Baltimore and during two years on that duty, he greatly increased the efficiency of the service in that district. He found many political appointees, more or less incompetent, in charge of lighthouses and caused their removal; thereby creating some enemies who caused his being put on waiting orders. In 1886 the Baltimore and Ohio Railroad borrowed him from the Navy Department to act as chief inspector of steel for a new bridge of that material, the first of its kind on their line. Soon afterward he cooperated with William C. Whitney who became Secretary of the Navy and together they divorced the operation of the lighthouses from political influence. Mr. Whitney appointed Evans chief steel inspector of his department and he was the means of changing the steel specifications for the new Navy, so that the plates produced were harder than any ever before known.

After a time Secretary Fairchild of the Treasury had him made secretary to the lighthouse board. In this position he improved the quality of the lighthouse keepers, and carried out a long-cherished plan of getting them all into uniform which increased their self-respect and efficiency. He caused many improvements, established electric lighted bouys along the channel into New York harbor so that ships making Sandy Hook in the night, could come up and anchor in safety at quarantine. This was the first port in the world to be so lighted. During this period he also acted as superintendent of construction of the first *Maine,* then just started at the Cramp's Ship Yard at Philadelphia and making very slow progress. He succeeded in speeding things up at Cramp's and worked so hard at both jobs that he told a friend, "He had heard that it was better to wear out than to rust out, and he saw no danger whatever of his accumulating any rust, as he had to divide his time between Washington and Philadelphia which meant many

hours of extra work." Admiral Evans, in spite of his early wounds, was a man of fine physique and excellent health, or he never would have been able to survive the strains he had to endure in his long and arduous service in the Navy.

The intelligence and diversified abilty of this unusual man and his value to the department are shown by the fact that the government sent him to Appleton, Wisconsin, to erect a sulphite-fiber mill through a winter when the thermometer often went to thirty degrees or more below zero. He said of this undertaking: "The air was dry and I enjoyed every hour of the time. My water power was at last harnessed, and when all the water wheels were running and the vast mass of machinery doing its work, I felt repaid for my labor. The knowledge I gained was of great benefit to me afterward when I found myself in command of a ship with her seventy-odd engines of various kinds."

In August, 1891, Commander Evans was placed in command of the steel gunboat *Yorktown* which in September of that year was ordered to Chile, where under the most trying circumstances he was called upon to display all of the tact, patience, and diplomacy there was in him, as we were soon to be on the ragged edge of war with that country. Here, as will be seen later, he acquired the sobriquet of "Fighting Bob" which went with him through life and which would seem properly to have belonged to this pugnacious individual from early boyhood. The *Yorktown* was only 1,710 tons, armed with six 6-inch B. L. R. two 6-pounders, four 1-pounders and a couple of machine guns. Her complement was only 195 men. With this little force he was called upon, as will be seen later, to defy practically the entire Chilean Navy for a period of nearly seven weeks. All who knew him expected the courage which he displayed through those exasperating weeks when a single false step on his part would have precipitated us into war; but they marvelled at the patience and diplomacy shown by him when his temper must have been on edge, and he must have been boiling with indignation inside.

The *Yorktown* left New York on October 8, 1891, proceeding, after stopping at various ports for coal, through the Straits of Magellan to Valparaiso, Chile. It took fifty-one days to make the passage, much of it in villainous weather. He arrived about December 1, to find the *Baltimore* there, and that two of her men had been murdered and eighteen wounded in a drunken brawl

ashore. It was apparent to anyone who studied the affair, that our unarmed men had been attacked most unjustly by an infuriated Chilean mob, assisted by the Valparaiso police and some soldiers. The country at the time was between two revolutions with little civil authority and greatly unsettled. This, however, was no excuse for an unprovoked attack on the naval men of a friendly nation. The *Baltimore,* in command of Captain W. S. Schley, was leaving for the north in a few days and the little *Yorktown* would have to face the hatred of all North Americans which had developed out of the rumpus, also to handle the open hostility and insults to which all of his officers and men (including himself) were subjected whenever his boats had to take anyone ashore. It was easy to keep his men on board, but our minister (Mr. Egan) was at Santiago, the capital, some twenty or more miles inland, and frequent conferences between the commander and Mr. Egan were absolutely necessary. This meant that a boat had to bring Evans ashore, and wait around to take him back to his ship. The whole Chilean Navy was anchored around the *Yorktown,* and three German warships with three Frenchmen were also in the harbor. It should be borne in mind that practically all the dispatches for Commander Evans had to come through our legation at Santiago. This meant that he had to go there every few days. From the minute he landed, all the way to the railway station in Valparaiso, he was followed by spies, by uniformed police thoroughly hostile, and by more or less of a mob with no good-will. On arrival at Santiago it was the same, with the legation surrounded while he was there. The return to the *Yorktown* was made under similar conditions. Nothing but scowls and muttered threats met him all along the line. It is easy to imagine how this kind of a man had to figuratively sit on his own safety valve, to prevent its popping under such circumstances. A threatening wave of his walking stick would have precipitated an assault on him.

The commander scrupulously made all the usual formal calls on the Chilean port and naval officials, and punctiliously observed all the official etiquette. He felt deeply the need of another United States warship in the port for his moral support at least. But his handling of this most difficult situation makes it seem wise that he was the senior American naval officer present. The size of the ship did not matter, it was the *size of her commander*

that counted most. And he might have been under some senior of much worse judgment, and less courage. The full details of this affair are published and well-known to all readers of history; but I will mention certain Evans characteristics, which show forth most delightfully through the whole business.

In December he began to hear rumors that the *Yorktown* was to be destroyed by some form of night attack. Therefore from the thirtieth of that month, her guns were kept loaded and the crew slept at their battle stations. Notice was given to the Chilean admiral that any vessel approaching the gunboat after dark would be fired on without notice. On January 8, 1892, one of his boat crews, awaiting his return from Santiago, was stoned and hit. Evans at once notified the Chilean admiral that thereafter all his boat crews would be armed with loaded rifles and any man seen throwing stones at them would be shot dead. From then on stone throwing became very unpopular and his waiting crews were not again molested. Soon after this the captains of several torpedo boats started the pleasant habit of rushing full speed at the *Yorktown,* then jamming their helms hard over and going by her with but few feet of clearance, sometimes less than six.

The Chilean admiral was thereupon favored with another note to the effect that from then on, if any more of their torpedo boats headed for her they would be fired on with 6-inch guns as soon as they passed a certain radius. Curiously, this amusement also ceased at once.

About then, Commander Evans heard rumors that the *Baltimore* matter was to be left to arbitration. That day he wrote in his diary; "When the United States is willing to submit the murder of her sailors in uniform to arbitration, I must seek other employment." He also naïvely admits, "that the situation was telling on his temper"; which can easily be believed. Knowing the man, it is a marvel that he kept control of himself and did not blow up and ruin the whole situation. This dreary and tense condition hung on for seven weeks, before our government ordered the *Yorktown* to carry certain refugees who had sought asylum in our legation at Santiago, to Callao and there await orders. Meantime, this lone little United States naval vessel in charge of a courageous and able commander, far from home and with very uncertain means of communication, with no other United States

warship within 1,200 miles (Callao), dominated and held down an intensely critical situation, when a very slight blunder by Commander Evans would have precipitated war. Meanwhile the honor and self respect of his country was most faithfully guarded. It is easy to imagine with what intense relief and joy the men of this doughty little warship sailed away to the north on January 20. How they must have slept the first nights out!

In June, 1892, Commander Evans was placed in charge of five gunboats and old cruisers, together with several revenue cutters, and ordered to Bering Sea to put an end to pelagic sealing. Here was another job requiring courage, tact, and discretion, for it was known that some 110 schooners were engaged in this destructive work and that they were under Russian, Japanese, Canadian, British, and even American flags. The work was disagreeable, cold and in rough seas mostly uncharted and unlighted. International complications were more than easy. But this arduous work was well carried through and no less than 107 of these seal pirates were warned to get out and stay out, with no ensuing complications. There is no doubt but what the many "pirate" captains who had a personal interview with the commander of the *Yorktown,* left his presence with the firm conviction that here was a man who could not safely be fooled with. For his excellent work in Bering Sea he was commended by Secretary Tracy and especially mentioned by the President in a message to Congress. Few officers have had that honor in time of peace.

For a time the commander was again attached to the lighthouse board as naval secretary, where he had many pleasant trips with President Cleveland and members of his cabinet who liked to go about on the lighthouse tenders. Soon after his return from the north he was promoted to the rank of captain and in 1894 was given command of our new (and only) armored cruiser, the *New York.* As he was a low junior on the list, it was a distinct mark of honor. Any officer might have been justly proud to command this fine ship for, to the writer's mind, the first *New York* (now under another name) was and is the prettiest steel ship in the Navy. She was a flagship and here Captain Evans served as chief of staff to Admiral Richard W. Meade until his retirement.

The Kiel Canal celebration was looming up and the *New York* was one of our ships ordered to attend it. She sailed for that port about May 20, 1895, arriving in due time. As one of the newest ships in the international fleet gathered there she attracted much attention, especially from the ever-vigilant Kaiser. Such a real man as he was then would certainly be attracted by such another real man as Captain Evans. In fact the attraction was mutual. Of course there was much entertaining on this kind of an occasion and one evening our Admiral Kirkland gave on the *New York* a dinner at which were the Emperor, his brother, Prince Henry, and ten admirals. The meal lasted long and late and at 1 A. M. the Emperor expressed a wish to inspect the ship thoroughly.

He was taken everywhere and shown everything. At about 2 A. M. he and Captain Evans were out on the forecastle when the Emperor asked, "How long would it take to close all the water tight doors?" The captain replied, "About thirty seconds in daylight and two minutes at this hour." The Emperor requested to be shown. Evans tried to blow the siren but there was no steam, at which the Emperor said, "Now you see, captain, you can't do it." Captain Evans replied, "You will see in a moment, sir." Evans pressed one of the general alarm buttons which called all hands to quarters, in a few seconds, the men were swarming all over the ship. The Emperor stood with his watch in his hand while in one minute and a half, the ship was ready for action with all water-tight doors closed. When they went aft where everybody could hear him the Emperor said, "Captain Evans, I cannot imagine that a ship could be in better condition." Which praise did not displease our captain one mite.

In the spring of 1898 when the Spanish War broke out Captain Evans was in command of the battleship *Iowa*. Many terse and unique sayings as to what he would do to the Spaniards if given a chance became current, some true and some untrue. Anyway the public loves a he-man and they served to confirm the name of "Fighting Bob," which never left him. It is not affirming too much to say, that he became the most popular officer in our Navy. Anyway the *Iowa* fired the first gun at Cervera's fleet when it came out of Santiago, as might have been expected. His record during that war is too well known to need comment. He used to tell a delightful story of an ex-

perience when off Cienfuegos. The *Iowa* was lying off that port late one afternoon, when a transport came along and delivered to that ship some forty recruits from the Michigan naval reserve as she was short of her complement. They were a big husky lot, pretty green about warships but evidently excellent material with which to complete a crew. They arrived so late that nothing much could be done with them except to assign their station billets before darkness came on.

About midnight that night, it was reported that one or two Spanish torpedo boats were coming out of Cienfuegos, and the *Iowa* beat to quarters and the men went to their battle stations. Captain Evans was just coming out of his cabin and hurrying forward, when in the dark he felt someone pull his sleeve. He stopped to see who it was, when a man said to him, "Say Mister, I came down here to fight and I want to fight, but I don't know where I ought to go to." The Captain looked at him and saw that he was one of the green Michiganders so lately come aboard and meant nothing by his manner of addressing him, as he knew no better. He replied, saying; "You have a station billet, haven't you?" "Yes," said the man, "I have some kind of a card they gave me." "Let me see it," said Evans. He went where he could see to read it and then said to the man, "You belong in the starboard after eight-inch turret;" handing it back to him. "Yes, Mister," said the man, "but how in Hell do I get to it?" The Captain kindly went part way with the man so that he could not go wrong, and then hurried forward to the conning tower. How many battleship commanders at such a time would have taken so much trouble to set a green hand right? It was such incidents that caused his great popularity with all of his crews.

In token of this, in February, 1899, he was presented by the crew of the *Iowa* with a beautiful sword and a written testimonial reading as follows;

U. S. S. *Iowa*,
San Francisco, California,
14 February 1899.

Captain Robley D. Evans, U.S.N.
Washington, D. C.

SIR:

The members of this ship's company, who had the high honor of serving you from San Juan to Santiago, beg leave to present this sword as a token of our affection and reverence.

It had been our intention to make this presentation when you relinquished command, but owing to the disintegration of the crew following our arrival at New York in August last, and our hurried departure, it was not done. Coming at this late day, it will show you, sir, that this action is not from momentary impulse, but that the affection and respect of this crew for you is deep rooted and lasting, and that the men of the battleship *Iowa* will ever cherish the memory of their beloved commander.

And with this sword we send our wishes for your health and happiness always. It is an assurance from us that you are *more* than a hero to a *nation—you are a hero to your men.*

Very respectfully,

[Signed by a committee of five of his crew.]

At a reception at the Chamber of Commerce in Cincinnati a white-haired old gentleman took Captain Evans by the hand saying; "Captain, I want to know how it feels when you are sure that there are seventy millions of people each one of whom would like to look into your eyes and say, 'God bless you'?" Evans was greatly moved by these incidents and said, "that it was worth all that he had gone through or expected to have to endure, to have such appreciation from his fellow countrymen." The sword became his most highly prized possession.

While still in command of the *Iowa,* he was visited by Rudyard Kipling, who expressed much admiration for the captain. Later on he sent him a set of his books and on the fly leaf of the first volume was written a new poem entitled: "Admiral Evans," with a reference to his illustrator (Zogbaum). I will quote only the first and last verses;

Zogbaum draws with a pencil,
And I do things with a pen.
And you sit up in a conning tower,
Bossing eight hundred men.

. . . .

To him that hath shall be given,
And that's why these books are sent.
To the man who has lived more stories,
Than Zogbaum or I could invent.

The point of this quotation lies in the third line of the last verse, for where could be found another of his age who "had *lived* more stories" than had Admiral Evans since he was seventeen years old, and more were still to follow. I had the pleasure of sending him many press clippings of stories and say-

ings attributed to "Fighting Bob," and the reply to about three-fourths of them was, "These are news to me."

When Prince Henry of Prussia visited the States, Admiral Evans was appointed his special aide and escort as he had met him at Kiel. He never left him while in this country and the experience added many new stories to his repertoire, together with some caustic comments on the ineptitude of some of our people toward visiting royalty.

In 1902 he was ordered to the Far East where he took command of our Asiatic fleet. Happening to be in Japan at that period I saw considerable of both the Admiral and his family. He there asked me how I liked his first book *A Sailor's Log*. My reply was that in reading it I felt as if we were sitting in a room some evening with a couple of good cigars going, and perhaps a little moisture nearby, while with crossed legs he told me the story of his life. "Mr. Tyler," said the Admiral, "that is the best criticism of my book that I have heard from anyone." While in command out there he greatly improved the dotter and sub-caliber firing of the fleet and invented a new loading machine long used in the service. In 1907 he much improved our system of fire-control assisted by an able board appointed by himself. During that year it was decided to send our battleship fleet around the world, and Rear Admiral Evans was appointed its commander-in-chief.

This "Armada" assembled at Hampton Roads in December where it made a wonderful spectacle. It consisted of sixteen battleships and a vast number of destroyers, auxiliaries and supply ships. It was ordered to sail December 16, and on that morning President Roosevelt arrived in the *Mayflower* to review the fleet and wish it God speed on its long voyage. Admiral Evans conducted it through the Straits of Magellan and as far as Magdalena Bay, (13,000 miles), where target practice was had. But here his ancient enemy rheumatism caused by his Civil War wounds, got the better of him and he was compelled to turn the ships over to his second-in-command, Rear Admiral C. M. Thomas, and seek relief at the Paso Robles Hot Springs. There he recovered sufficiently to meet the fleet at San Francisco and take part in the celebration, but he soon commenced to suffer again and the doctors ordered his retirement.

This was confirmed from Washington by the following letter from President Roosevelt;

The White House,
Washington, March 23, 1908.

MY DEAR ADMIRAL;

It is with very great regret that, at your own request, I relieve you from command. You have now practically finished your active service in the United States Navy, and you have brought your long and honorable career, identified to a peculiar degree with the whole history of the Navy, to a close by an achievement which marks the entrance of the United States into the rank of naval powers of the first class. In your early youth, as a young officer, you won a reputation for signal gallantry in the Civil War. You have closed your career by conducting a great battle fleet from the North Atlantic to the North Pacific in a manner which has shown you to be a master of your profession. The fleet comes to San Francisco in better shape than when it left Hampton Roads—better fit for service in every way; and the officers and men owe no small part of their improvement in their profession to the mastery of your profession which the handling of the fleet has shown.

With thanks, congratulations, and good wishes, believe me,

Sincerely yours,

THEODORE ROOSEVELT

On his return to Washington, the President told Rear Admiral Evans that he had used all his influence to have Congress make him a vice admiral, but without success. It should be borne in mind, that never before had a modern fighting fleet of this size been conducted such a distance. It should also be recalled that its commander had characteristically announced just before sailing, "that the fleet was equally ready for either a frolic or a fight," which caused uneasiness in certain quarters.

Without doubt, this forced retirement because of ill health at the very apex of his forty-eight years of service was a grievous disappointment to the admiral, who hoped to crown it by taking this great fleet throughout its entire cruise, the first of its kind. He had achieved flag rank in 1901 at the age of fifty-five, which made him near the official retiring age (62), but had he kept his health, he would probably have been retained in the service a few years more.

He returned to Washington by rail, receiving ovations at every principal station, so high did he stand in the estimation of the public, who deeply sympathized with him in his having to give up so great a command on account of old wounds received in

action. He went on the retired list August 18, 1909, settling in Washington where he died suddenly from acute indigestion on January 3, 1912, at the age of sixty-six. He left a wife, two married daughters and a son, now Captain Franck Taylor Evans, U. S. N. He was deeply mourned both at home and abroad, where he had many friends, for "Fighting Bob" was known and respected wherever warships go and wherever naval officers foregather. Of the many tributes to his courage and great ability, want of space permits the mention of but a few.

President Taft said; "Admiral Evans was one of the most successful squadron commanders we have had in the Navy for a long time; he was a rigid disciplinarian, of quick decision, and admirably advised in the intricacy of the machinery of battleships, and skilled in drilling them."

Secretary of the Navy Meyer said; "By the sudden death of Admiral Evans the country loses one of its most brilliant and able officers. It was on account of his ability that President Roosevelt selected him as commander-in-chief of the fleet to cruise around the world. . . . ."

Former Naval Secretary Metcalf said in part; "He was practically an ill man when selected for this important duty [commanding the world fleet], but his splendid record justified the Navy Department, of which I was then in charge, in giving him this recognition of his long and efficient service. He was one of the most efficient and capable officers the Navy has known, and his name has been a household word for many years."

Admiral Evans had probably met the rulers of more nations, and more distinguished officers of both their services, than any other naval flag officer in our history; and so favorable was the impression he made, that none of them ever forgot him afterward. A list of these would be too long for this paper, but among his intimate foreign naval friends might be mentioned Admiral Prince Henry of Prussia, Admiral the Duke d'Abruzzi of Italy, and Admiral Prince Louis of Battenberg (British), while Admiral Lord Charles Beresford was a chum of a quarter of a century's standing. These two fighting "Sea Dogs" had much in common to draw them together, and in both the British and American services they were spoken of respectively as "Fighting Charlie" and "Fighting Bob," in innumerable stories told aboard warships.

After his retirement, the Admiral enjoyed about two and a half years of Washington life during which he retained an intense interest in the Navy, and his enforced inactivity must have worn on him.

Robley D. Evans was nothing if not honest; whether in praise or in criticism, his speech was most direct and generally hit the bull's eye. One always knew exactly where to find him. Of course his bluntness made him some enemies, but no man ever rose to the top of his profession without this result. In order to get up in this world, some heads have to be trodden on. It is unavoidable. The soft and easy spoken seldom get anywhere. Mr. Roosevelt's motto, "to speak softly and carry a big stick," is excellent advice, but everyone cannot do it. To illustrate Admiral Evans' directness of speech, I will quote only one instance. In conversing with him in Yokohama, I happened to mention one of our naval officers who had been much in the public eye and who had received a great deal of criticism. "What do you think of him?" said the Admiral. My reply was, "that he seemed to some of us on shore to be a good deal of a d—d fool, but that I did not expect *him* to say anything about the man." "Of course he's a damned fool," said Evans, "he was one on the day he was born, and he has never missed being one any of the days since then."

There is a story that Admiral Evans once attended Trinity Church, New York at a Sunday service; an usher showed him into one of the best pews there and the wealthy owner arrived soon after. Not knowing who was in his pew, the man took out a card and wrote on it, "I pay $1,000 a year rent for this pew," and handed it to his undesired guest. The Admiral looked at it a moment, then took out his own card, wrote on it "You pay too d—d much," and passed it over to the owner.

After reaching flag rank Admiral Evans published two books, both of surpassing interest even today, especially to any lover of the sea. The first, *A Sailor's Log,* appeared in 1901 and the second, *An Admiral's Log,* in 1910. They are both books that will bear reading several times, for they are a distinct part of the history of our modern Navy. In writing this "Appreciation" these works have been drawn upon, also Maclay's *History of the Navy,* as well as personal recollections of one of the most valued friendships of the writer's life.

LET'S CONSIDER ACCOUNTING

By Lieutenant Commander P. J. Searles, (C.E.C.),
U. S. Navy

I WONDER how many officers of the Navy are completely satisfied with the present accounting system as it applies to navy yards and naval stations, industrial and non-industrial. After a series of queries which, of course, has not been thorough nor, possibly, representative, and after some years of personal observation, I have come to the opinion that the accounting system now in vogue does not give the satisfaction which might be desired. Not, of course, that I dare pose as an expert in accounting, competent to suggest a definite, final system; far from it. The fact being that the avalanche of accounting instructions, forms, reports, and the like has so completely buried me that breath is almost extinct. But even a layman, an outsider, who is interested in results, may be permitted an expression of opinion and the privilege of making general suggestions. This plaint should, therefore, be considered only as the cry of one from the wilderness.

Just what information should an accounting office be prepared at all times to give? Eliminating the data required by the general accounting office, and with which we have no concern; and those final records which may be essential for departmental or congressional information, the two definite items of information which may be required by the industrial division of a navy yard are: (1) statement, up-to-date, of the standing of appropriations or local allotments therefrom; (2) statement, up-to-date, of the actual (not appropriation) cost of any or all jobs.

As these requirements are now entangled and difficult to separate on the present forms and reports, and as they are needed for different purposes, it seems desirable to divorce appropriation and cost accounting on the grounds of incompatibility and assign to each a separate domicile.

At present so-called daily statements are prepared by the accounting office and submitted to industrial divisions showing appropriation standings, and the final statement on a job is supposed

to show its cost. Actually, however, such daily statements are always several days late and the final statement does not show actual cost—but only that part charged to a definite appropriation. The fault cannot be laid at the accounting office doors even though it is a foundling, as the personnel concerned are laboring under the handicap of a cumbersome system. On many jobs the receipt of daily statements several days late is not of much concern, but when expenditures are closely restricted, any delay toward the end of a job may lead indirectly to an overexpenditure and the consequent unpleasantness to all concerned. Especially is this true toward the end of a fiscal year. Even at other times delays are not desirable because uncertainty of appropriation standings may hold up essential work, starting of which is contingent upon remaining funds available. Of course the heavens never fall because a particular job is not started on a particular day, but in the interests of efficiency, accurate time planning is desirable. I repeat, the accounting personnel is not responsible, for delays may be due to unpriced stubs (beyond the supply officer's control), errors in time checks and time charges, and especially to the complexities of indirect overhead, shop rates, and all the other rigmarole. Some industrial divisions have even found it necessary to keep more or less private accounts in order to keep up to the minute, contrary though this may be to the spirit (if not also the letter) of the regulations.

Similarly with cost accounting—though the mere mention of "cost" is ludicrous as well as painful. Who knows the actual, honest-to-goodness cost of any navy yard job? I confess frankly I don't. That part of the cost chargeable directly to specific appropriations is easily ascertainable, but the real, genuine cost is as elusive as the mysterious "X" to a beginner in algebra. Later (ah, how much later), all, or nearly all, charges may be assembled in the department or in the general accounting office, but of what value is this to the officer in a yard who wants a definite and immediate figure, possibly for accurate and actual estimating? In estimating, the cost of laying brick last year with perhaps a totally different gang of bricklayers is not of much value; what is wanted is the cost *today*. Title O material purchased locally is not chargeable, either in appropriation or cost accounting, until the requisition has been approved by the department, even though, as in the case of isolated colonial stations, the material may have been

in use many months before such approval is received. Of what value is a fictitious cost which neglects to consider (or considers next year) possibly essential and expensive items? The division doing the work *must*, in such cases, keep some office accounts, thereby partially or wholly duplicating the accounting office work.

How can a responsible officer know how much a job is going to cost or how deeply *his* allotment will be involved when the unit price of electricity, air, or steam may fluctuate, when shop rates vary widely due to leave and holiday pay, etc., and when estimating and planning is a somewhat uncertain quantity? He cannot know, and, as accurate accounts are essential, why should not the present unwieldly system be simplified, amended, or changed completely to provide the desired information in a clear, straightforward, and up-to-date manner. Departmental or congressional action may be necessary, but surely these are not impossible to procure. As one possibly in the category of "fools rush in," may I offer certain suggestions, not of details, which is a matter for qualified experts, but of fundamentals, with a view to procuring an accounting system which will give information when, where, and how wanted?

As stated before, cost and appropriation accounting should be divorced, for as it stands now neither means much to the man who does the worrying about funds. With this done, appropriation accounts could be handled so as to keep all concerned acquainted at all times with the state of their funds. Expedition could be secured perhaps by some of the methods discussed later. Cost could be kept on all jobs if absolutely necessary, but probably it would be found that such records would not be needed in many, perhaps a majority, of cases. By cost, I mean *actual* cost, as closely as actual cost can ever be secured on industrial work. Of course I realize that such costs are not, and cannot be, as accurate as real costs kept by commercial factories, for in the Navy items such as pay of officers, interest on shop investments, depreciation, etc., are to a large extent considered as military necessities and consequently not chargeable. However, a closer approximation should and can be secured. The question of losing cost accounting altogether, or murdering it outright, might well be considered.

The bugbear of appropriation accounting is overhead. How simple it seems to state that the shop rate for some particular shop is, say 50%, this covering all the items that make up the so-called

overhead. But how difficult this is in practice, and particularly so in the practically impossible task of long time predictions, and how misleading the rate at any given time is to an estimator. Consider a yard where shop rates are determined monthly, as is usually the case. Suppose a "building trades" shop rate for any month is 50%. This is made up of a number of factors such as some planning and estimating, leave and holiday pay, non-productive work, electricity, compressed air, steam, in general all those items which are not directly charged to specific, so-called productive jobs. These factors naturally vary, and vary considerably with work load, type of work, etc., so that at the end of a month there certainly will be some difference between the estimated and the actual rate.

This under- or over-absorbed is applied to the estimated rate for the next month, and the rate increased or decreased. No one can possibly tell today what a shop rate will be in six months. Hence the plight of an estimator can easily be seen. He may be preparing figures for an estimate to be presented to Congress and upon which an appropriation will be based. But if he uses the shop rate of today—and use it he must, his figures may, and probably will be considerably inaccurate by the time money is available; perhaps the funds appropriated will not be sufficient for the work. Similarly with the accounting of appropriations, no one can tell what will happen in the future, and hence allotments to the various yards are necessarily of vague application.

The obvious remedy is to do away with indeterminate, and make all charges determinate to some definite appropriation. For example: certain charges in the transportation section of a navy yard are of the variety later applied to indeterminate. These are distributed over the various shops and divisions using transportation. Later some shop, say a machine shop, may do work for the transportation section, and charge the machine-shop shop rate to the labor on the job order. But this machine-shop shop rate in itself contains some of the transportation original direct and indeterminate charges, so the cat (or at least some of its fur) finally comes home where it belongs. But how absurd all this running around in a circle to the annoyance of all and at the expense of a huge accounting system. Why not make all charges definite and determinate? Could not the public works department in a yard operate and maintain transportation, paying all costs from

a definite yards and docks appropriation? The ultimate and actual cost would be practically unchanged, and the accounting would be reduced in volume.

Similarly, why not an appropriation for power plants covering all costs of every variety? Then no one need be bothered by unit costs of steam, electricity, air, etc., except—and this is most important—the man in charge of the power plant whose professional reputation would depend upon results. Or perhaps, as is now done in the Philadelphia yard, the appropriation "Maintenance, Yards, and Docks," could be used for carrying all charges, and unit costs could be determined for comparatively long periods, up to a year say, so that each user would know at all times and definitely what his costs would be. The carrying appropriation would of course alone be affected by profit or loss.

Two objections might be argued against either of these two proposals. Against the first it may be said that users would not be interested in economy in their use of the power plant's output. The rebuttal of this will be given more fully later, but here it may be said that surely we can trust the users (usually reputable officers) to look after the general interests, financial or otherwise, of the Navy and of the government. If carelessness or shiftlessness occasionally develop, they can be remedied by disciplinary action, just as similar faults would be cared for on board ship and in a military sense. Against the second proposal above it might be argued that "Maintenance, Yards, and Docks," would always profit and never lose by virtue of being a carrying appropriation. Again I say, naval officers can be trusted to do their duty properly and not seek personal or corps benefit only. If laxity should infrequently develop, surely it could be remedied by any commandant worthy of the name, who could inspect books and records and determine where the fault, if any, lay.

Next consider a joiner shop or machine shop, whatever you please. The black pall of indeterminate with its abracadabra of underabsorbed leave pay and the like, could be lifted just as in the case of power plants, so briefly outlined above. A shop, all its work, all its output, *everything,* could be charged to some definite appropriation under the proper bureau. The money all comes from the same original source, we are all working for the same end, so why split hairs, divide funds with unnecessary nicety, and wrangle over it all like an Armenian selling goods to a Turk.

Surely we can trust shop superintendents to serve all customers impartially, and punish the few delinquents by notes on their professional records or by any other means found necessary.

Another method would be to determine for a shop, a unit charge for service, to extend over a considerable time. For example make "engineering" a carrying charge for a machine shop. Charge everything connected with its operation and maintenance to the general appropriation, and from the *total* costs, determine machine rates (in a manner analogous to determining unit costs in a power plant), and charge users these unite rates. We charge outside firms definite unit prices for the use of our equipment; why could not something of this kind be done with each other?

No matter which method might be followed, the commandant, through his assistants, could determine such things as priority of work, proper unit charges and the like. There would surely be keen endeavor in all shops to reduce appropriation charges, or to perform work at a reasonable unit machine rate, as upon such matters would depend the professional reputation of the officers concerned. If the machine rate for a planer, for example, were appreciably greater or lower than similar rates in a commercial firm, it would redound to the credit or discredit of the shop superintendent. Such an officer surely would not endanger his reputation for the sake of benefiting some appropriation, and if a few did succumb to this temptation, the resulting outcry from their customers would set matters right.

Perhaps there may be other ways of accomplishing the desired ends. This article is intended merely to focus attention on what many consider a sore spot, and to start an argument having as its aim the setflement of some of the difficulties encountered in handling navy funds. Summarized my suggestions are:

(1) Separate cost and appropriation accounting and eliminate the former if generally considered desirable.

(2) Make all charges determinate to an appropriation and get rid of all the cumbersome accounting of indeterminate.

(3) Make one definite person responsible for each appropriation and allotment, and for each kind of work performed.

(4) In general arrange the accounting system so that it will be of real value to the man handling funds, and will not be only a mausoleum of lost endeavor.

A SUGGESTED SMOKE SCREEN INDICATOR

By Commander W. L. Mann (M.C.), U. S. Navy

Description—The device consists of a section of celluloid graduated into degrees; at the center of the section two arms are pivoted, one known as the "wind bar" (a) and the other known as the "course bar" (b). The "course bar" has a pivotal "cross-arm" (c) on a slide, and attached to this is a circle, graduated to read, to right or to left, from 0 to 180 degrees.

Principle of the Smoke Screen Indicator—As is well known, the front edge of a smoke screen is a resultant of the force and direction of the wind, with the speed and course of the smoking vessel, or otherwise expressed we have the following variables:

(1) Force of the wind.
(2) Direction of the wind.
(3) Speed of the smoking vessel.
(4) Course of the smoking vessel.

The combination of the four factors determines

(5) The direction of the smoke.
(6) The speed that an initial particle of smoke will travel with reference to the smoking vessel.

Object—To provide a simple and rapid method for ascertaining the angle which the smoke screen will bear to the course of the smoking vessels, and the distance an initial particle of smoke will travel in a given time, under given conditions of the force and direction of the wind. Or, if any four of the above six facts are given, the remaining two may be found.

Advantage—It is a simple device which may be readily improvised from the materials available aboard any ship and for this improvisation a protractor with cardboard arms attached to its center by means of a bent pin, may be utilized.

Directions—(1) Place the "wind bar" (a) in the direction to which the wind is blowing.

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340
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330
320
310
NW
300
290
WNW
280
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210
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A
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LAYER.

C
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SPEED LAYER.
FAN-LL EDGE OF SHORE AND DISTANCE IT TRAVELS IN THOUSANDS OF YARDS.
COURSE OF SHIP
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130
140
150
160
170
180

(2) Place the "course bar" (b) towards the course of the vessel which is laying the smoke, *i. e.,* smoking vessel.

(3) Place the "cross-arm" (c) so as to intersect the speed of the smoking ship on the "course bar," with the force of the wind on the "wind bar."

(4) The angle between "course bar" and "cross-arm" thus obtained is the angle which the *smoke screen will bear* to the course of the smoking vessel. (By the use of parallel rulers the true direction may be obtained.)

The linear reading on "cross-arm" (c) where it touches the "wind bar" indicates the speed (knots per hour) an initial particle of smoke will travel when referred to the positions of the smoking vessel.

(5) In case the smoking vessel changes course or speed, or the wind changes in force or direction, a new reading may be obtained immediately by changing the arms and bars to correspond with the new conditions.

(6) If the smoking vessel steams on parallel course to the enemy and at the same speed, then by having the enemy bear the same angle as above obtained, the enemy will be maintained in the smoke screen.

Since working out this device, (about two years ago), I find the same principle is involved in other devices, *e. g.,* the Battenburg Indicator, consequently no claim is made for the discovery of a new principle.

THE "PRINCETON" EXPLOSION

By Commander A. H. Miles, U. S. Navy

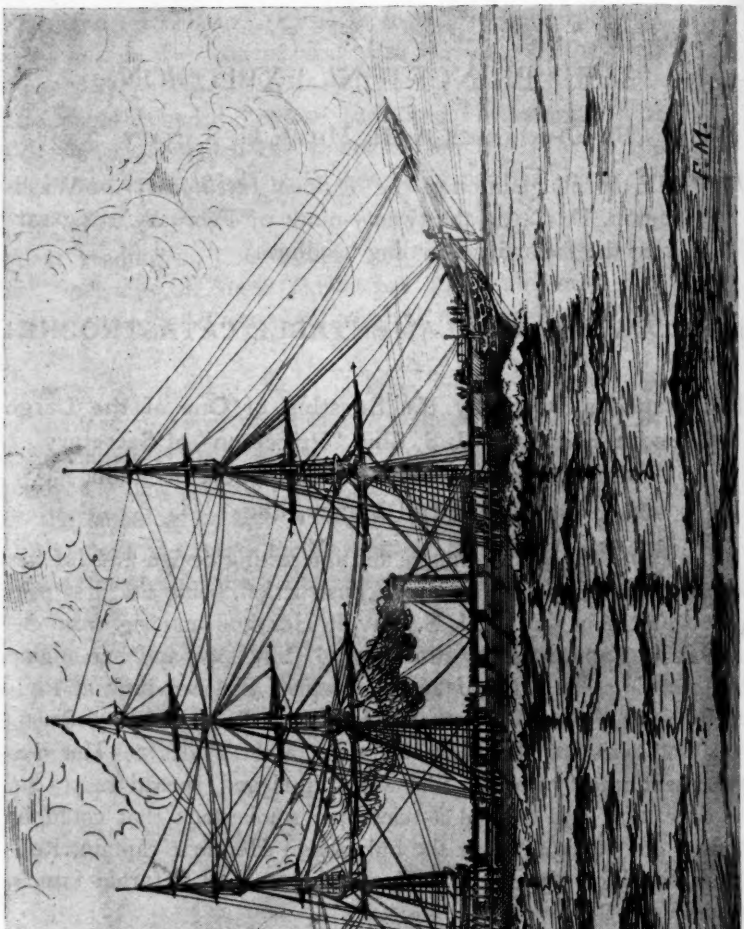
THE morning edition of the *National Intelligencer* of Washington, D. C., on the twenty-ninth of February 1844, carried the following startling headlines:

MOST AWFUL AND LAMENTABLE CATASTROPHE!

Instantaneous Death by the Bursting of One of the Large Guns on Board the U. S. Ship "Princeton" of Secretary Upshur, Secretary Gilmer, Commodore Kennon, and Virgil Maxcy, Esq.

The *Princeton* was of unique and interesting design and for her day a radical departure in naval construction, being the first propeller-built ship of the U. S. Navy. Her hull and rig were designed by Captain R. F. Stockton, U. S. Navy, and her engine by John Ericsson, later of *Monitor* fame. She was built at Philadelphia by Naval Constructor John Lenthall, at a cost of $141,819, and was 164′ long, 30′ 6″ beam, and 17′ draft. Her displacement was 672 tons. She was ship-rigged, spread 14,413 sq. ft. of canvas and carried a telescopic smokestack that could be housed out of sight below the bulwarks. Her first captain, Robert F. Stockton (later Commodore Stockton of California fame), describes her as:

> a full-rigged ship of great speed and power, able to perform any service that can be expected from a ship-of-war. Constructed upon the most approved principles of naval architecture, she is believed to be at least equal to any ship of her class with her sails. She has, also, an auxiliary power of steam, and can make greater speed than any sea-going steamer, or other vessel heretofore built. Her engines lie snug in the bottom of the vessel, out of reach of the enemy shot, and do not at all interfere with the use of the sails, but at any time can be made auxiliary thereto. She shows no chimney, makes no smoke, and there is nothing in her external appearance to indicate that she is propelled by steam.



U. S. Steamer "Princeton," 1851

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This daring combination of sail and wheel caused the captain to be enthusiastic over her tactical qualities, for he said:

> She can go in and out of port at pleasure, without regard to the force or direction of the wind or tide, or thickness of the ice. She can ride safely with her anchors in the most open roadstead; and may lie to, in the severest gale of wind, with safety. She can not only save herself, but will be able to tow a squadron from the dangers of a lee-shore, using ordinarily the power of the wind and reserving her fuel for emergencies. She can remain at sea the same length of time as other sailing ships. Making no noise, smoke, or agitation of the water (and if she chooses, showing no sail), she can surprise an enemy. She can, at pleasure, take her own position and her own distance from the enemy. Her engines and water wheel, being below the surface of the water, safe from an enemy's shot, she is in no danger of being disabled, even if her masts should be destroyed.

And as a sop to the economists, he added:

> The engines, being seldom used, will probably outlast two such ships. These advantages make the *Princeton,* in my opinion, the cheapest, fastest, and most certain ship-of-war in the world.

The *Princeton* was armed with two long 225-pounder wrought-iron guns, and twelve 42-pounder carronades, all of which could be fired at once on either side of the ship. It was said that her big guns could be fired with an effect terrific and almost incredible, and with a certainty heretofore unknown.

In the light of after events, this prophecy was only too true. The extraordinary effects were proved by firing at a target made to represent a section of two sides and deck of a seventy-four-gun ship. This target was 570 yards from the gun. Of these tests, Stockton reports:

> The shot passed through these immense masses of timber (57″ thick), tearing it away and splintering it for several feet on each side; covering the whole surface of the ground for several feet square with fragments of wood and iron.

Not only that but, with deadly accuracy, these guns could throw "their immense shot [3′ in circumference]" through the same horizontal plank in a target six times in succession a half a mile distant. Even with modern gunnery, this would be an excellent performance.

Stockton observed that the art of gunnery had for the first time been reduced to something like mathematical certainty, and that the distance from the ship to any object could be readily ascer-

tained with an instrument on board, contrived for that purpose, by an observation which it requires but an instant to make, and by inspection without calculation. Something our present range finders don't always do!

One would scarcely have thought that eighty-two years ago a ship of the Navy would use *director fire* but we learn that on the *Princeton* by self-acting locks, the guns could be fired accurately at the necessary elevation—no matter what the motion of the ship may be.

It was confidently claimed that this ship would be able to do battle with any vessel, however large, and that the improvements in the art of war adopted on board would be productive of more important results than anything that had occurred since the invention of gun powder. Her captain predicted "the ocean may again become neutral grounds, and the rights of the smallest as well as the greatest nation may once more be respected."

In the turbulent state of the times, with the administration and the public bent on the immediate annexation of Texas, the machinations of Great Britain, the Oregon boundary dispute, a Mexican war imminent and California looming in the Pacific, it is natural that an enormous interest was manifested in this invincible warship, not only by the President and his cabinet but by members of Congress as well. All officialdom eagerly awaited the coming of the *Princeton* to Washington. Disillusion, disappointment, and tragedy stalked nearby.

The *Princeton* was the pet and pride of her captain and the development of her great wrought-iron guns had occupied his constant attention for five years. Although the use of wrought-iron as a material for cannon had been attempted repeatedly from the invention of firearms, up to this time it had never been done with success except for very small calibers. The difficulty of welding large parts together perfectly had proved insurmountable. Bronze was the material most used, but overheating and distortion caused inaccuracy for fire; and because of lack of strength large charges and heavy projectiles were impossible. Cast iron was wanting in tensile strength and dangerous.

After the final tests of the big cannon in January, 1844, Captain Stockton in his reports to the Bureau of Ordnance and Hydrography waxed enthusiastic as follows:

As a gun, it is quite perfect, and I do not think that *any* charge of powder can injure it; and as a piece of forged work, it is certainly the

R. F. Stockton, U. S. N.
From a painting on ivory owned by his son, John P. Stockton

greatest achievement up to this time.* The men who made it deserve their money. It is worth all the guns on board of any frigate. It is safe in its carriage on board of the ship, and I hope within ten days to be with the ship at Washington.

After proving at Sandy Hook, this gun was taken aboard the *Princeton* at the Navy Yard, New York, and in due course arrived at the Capital for exhibition.

For the purpose of testing the mounts and firing mechanism, several preliminary trips were made down the river with various officials on board. That President Tyler evinced an unusual interest in the ship is certain for he accompanied the captain on her second test trip to see the guns fired. A third excursion with members of Congress on board was made and the bow gun, named the "Peacemaker," was fired for them three times, using 25-pound powder charges and 100-pound hollow shot. A thorough examination of the gun, both inside and out, after these tests, disclosed no defects.

When they did a thing in the forties they did so with considerable earnestness and conviction, so Captain Stockton, to gratify public curiosity and in keeping with his hospitable nature, sent out some hundreds of invitations to a grand fête on board the *Princeton* to witness the workings of the ship and see the big guns fired. The twenty-eighth of February, 1844, dawned bright with strong westerly breezes and the forenoon was taken up with extensive preparations to receive and entertain the distinguished guests.

Shortly after noon the steamboat *I. Johnson* came alongside with the President's flag flying. Following, the President and his cabinet with their ladies came aboard, members of both houses of Congress, a number of foreign ministers, army and naval officers from the War and Navy Departments, and other notables of high rank and station. Altogether the guests numbered 150 ladies and 200 gentlemen. It is imagined that the handling of such a throng presented difficulties, but in those days they were extremely partial to numbers and as long as there was a goodly sprinkling of the fair sex there could be no cause for complaint. Including the officers and crew, there were aboard this ship a

*Gun weighed 27,334 pounds, manufactured by Hogg and Delamater of New York at a cost of $11,488.22.

total of 528 souls. The yards were manned and the national salute of twenty-one guns was fired.

In President Tyler's own eloquent words:

When the morning of the ill-fated twenty-eighth of February dawned upon the world, the theretofore tempest-tossed administration found itself comparatively tranquil and at ease, reposing on the honor, the wisdom, personal friendship, and patriotism of its counsellors and advisers. That morning was also full of promise of a day of gladness and triumph—gladness and triumph at the successful accomplishment of an experiment which had been conducted under the superintendence and direction of one of the most gallant and talented officers of the Navy. The experimental ship, the *Princeton,* floated majestically on the bosom of the Potomac, and her projector and commander, distinguished not more for his valor than for his unbounded hospitality, had sent out cards of invitation for a fête on board, comprising a multitude. Never did the eye gaze on a brighter or more animated scene than that which the beautiful river exhibited during the forenoon of that fatal day. There floated the ship whereon had been concentrated so many hopes and anticipated joys. Decked out in trim array, there waved from every rope and yard some emblematic flag in token of our amity with the whole world, while proudly above them all floated at the mast-head our own beautiful banner. Numberless barges shot out from every cove and point, loaded with their living freight, and flew on the wings of hope and joy towards the gallant ship. The decks were soon crowded with a host of happy visitors. There was but one person in that crowd who did not partake of the hilarity which so universally prevailed, and that exception was found in the person of the interesting and admired lady* of the Secretary of the Navy. From the moment that her foot touched the deck of the ship a foreboding of evil took possession of her mind. The slightest separation from her husband caused her inexpressible agony. Vain were the efforts which were made to expel from her mind the horrid spectre of the future of that woeful day. The pall and the shroud floated before her vision and she was miserable. Like Cassandra, she prophesied of evil, and her prophecies were treated as the effects of womanly timidity and nervous excitement. Tell us, you who profess to look into the future, you who claim to have the power to read the mysteries which envelope cause and effect before they give sign of birth, what connection exists between the troubled mind thus filled with feverish apprehension, and the dread reality which afterwards occurs? With this exception, never was there assembled a more joyous crowd. A cloudless sky added to the brilliancy of the scene.

Among others, there were the Honorable Abel T. Upshur, Secretary of the State; the Honorable Thomas Walker Gilmer, Secretary of the Navy, and his wife; Senator Thomas Hart Benton of Missouri; Senator Phelps; Captain Beverly Kennon, U. S.

*Ann Elizabeth Gilmer.

Navy, of Virginia, Chief of Construction, Equipment, and Repairs; Virgil Maxcy, Esq. of Maryland, Chargé d'Affaires in Belgium, lately returned from a diplomatic mission at the Hague; Colonel David Gardiner of Suffolk County, Long Island (late N. Y. state senator) and his two talented daughters, Julia and Margaret, the former in June to become the wife of President Tyler; Representative H. C. Rives, of Virginia; the ex-Presidentess "Dolly" Madison; the Mexican minister, Señor Almonte and a Miss Summerville from Maryland. The senior naval officer on board was Captain C. Bolton.

Upshur from Virginia had left the secretaryship of the Navy the year before to succeed Daniel Webster as Secretary of the State. David Henshaw of Massachusetts was nominated as secretary of the Navy but for causes growing out of the state of times he was rejected by the Senate and Thomas W. Gilmer installed in the vacant secretaryship. Mr. Gilmer had formerly been speaker of the House of Representatives and a governor of the state of Virginia. At this time he had been Secretary of the Navy for only a few days, but he had entered already into the duties of his office with great zeal and high hopes for his Navy's future.

At 1:00 o'clock the starboard anchor was weighed and the ship with her joyous company steaming gracefully over the dimpled waters. All marveled at the smooth and rapid motion of the ship under her machinery and water wheel. As a demonstration, the propeller was thrown out of gear, and at the same time the three topsails set to try the effect of the wind alone. It might have been excusable had there been confusion in working the sails with such a multitude and so much gay chatter, but there was "entire order and discipline" a guest remarks, "at the belaying pin of every brace, sheet and halliard, a lady, a senator, or some dignitary of state would be courteously requested to move a little to give Jack a chance." At 1:45, the wind becoming light, the wheel was coupled up to assist, until a point a short distance below Fort Washington was reached, when at 2:20 the topsails were furled and the ship rounded to for the purpose of getting a long reach of the river for firing.

The central figure of this fateful drama now takes the stage—the monstrous "Peacemaker" is unleashed for the performance.

The crowd clustered around; Lieutenant William E. Hunt, U. S. Navy, the officer in charge, gave the order to load and:

A cartridge containing twenty-five pounds of powder was placed in the muzzle of the gun, a rammer with a head 9″ in diameter, made for the purpose, and marked to show when the cartridge was home, was used to slide the cartridge into the after part of the chamber of the gun; Mr. King, the gunner, attending with priming wire to report it home. A wad 10″ in diameter by 9″ long was then placed on the cartridge, and rammed home, completely filling the chamber; one round shot weighing about 212 pounds was rolled home against the cartridge wad with a rammer, the head 12″ in diameter. A wad 12″ in diameter by 6″ long was introduced and rammed home, the rammer marked to show when the charges were home.

When the "Peacemaker" was reported ready, Captain Stockton came forward, taking his usual position near the carriage, ordered others away to prevent any accident from recoil of carriage, and fired the gun. With wonderment the crowd thrilled at the thunderous report, the dense smoke, the deep rumble of the shell and the tremendous geyser of water thrown up. The immense range of the ponderous ball seemed to fulfill all that the valorous Stockton had foretold of their power. Examination of the gun showed everything to be well. At 3:10, being abreast of Mount Vernon, the ship wore around and stood up the river. At 3:20 another shot was fired under the same conditions as before with like effect.

The machinery had worked smoothly and the guns fired well, the exhibition planned for the day was happily over with no untoward event to mar the occasion. Secretary Gilmer, intent on the intimate knowledge of her material and structure, had visited every part of the ship, and mastered the entire fabric. The scene is now changed to below decks where a sumptuous collation in elegant taste is served. We can picture it in our mind's eye, the furniture of the cabins being made of white pine boards, painted white, with mahogany chairs, tables and sideboards, and an American manufactured oilcloth on the floor. The interior design of the vessel ideally accommodated itself to such a gathering, for to economize room and that the ship might be better ventilated, curtains of American manufactured linen were substituted for the usual and more cumbrous and expensive wooden bulkheads; by which arrangement, the apartments of the men and officers might, in an instant, be thrown into one and

a degree of spaciousness and comfort attained, unusual in a ship of her class.

One can imagine with what punctilious care the guests were arranged. The ladies were seated first, the gentlemen standing around them, toasting with champagne the President of the United States, the ship and her gallant commander. In response, the President gave this toast "Oregon, the 'Peacemaker,' and Captain Stockton." Oregon at this time was a bone of contention between Great Britain and ourselves and this bold toast throws some light on the live interest taken in the *Princeton.* After the ladies had partaken of the repast, they were succeeded at the tables by the gentlemen and one sees them over their Madeira and cigars listening to the merry quips of the most talented and witty among them. Upshur added to the zest of the conversation with his brilliant flashes of humor and Gilmer with lofty sentiments of patriotism. The center of all eyes was, of course, the President, tall and handsome with incomparable grace of bearing, whose silvery voice and elegant ease of conversation fascinated all. In his American notes Dickens wrote of "his mild and pleasant expression" and of his "remarkably unaffected, gentlemanly manners" and added that he thought that "in his whole carriage and demeanor he became his station singularly well." The ship's bell struck eight, it was 4:00 o'clock—the collation had refreshed and enlivened the guests—song prevailed.

They were still at the tables when word was brought down that one of the guns was to be fired again. On deck some gentleman had expressed the desire to see one more discharge which was assented to by the captain with the Secretary's approval, and immediately the company arose to go on deck and observe the firing—the long and vacant stretch in the river giving full room for the utmost range of the ball. The President and his cabinet went foremost, Senator Benton among them conversing with Secretary Gilmer. They took their places on the left of the gun—the President was called back—the captain was with this group which made a cluster near the gun, with the crowd behind and many all around. Lieutenant Hunter, in charge of the gun, who had made friends with Senator Benton, whispered to him that he could follow the shot better from behind the breech and gave Mr. Benton a seat on a carronade some six feet to the rear of the gun. Senator Phelps got on the carriage to his right, and

between the two a young lady from Maryland, Miss Summerville, was seated and supported by them.

After being called back, President Tyler went below in the company of the beguiling Julia Gardiner in fashionable array, wtih hair *en classique*—a previous friendship having ripened to something more. Whether by accident or design is open to conjecture, but here they were in the comparative quiet and seclusion of the cabin and this fact alone saved the life of the President of the United States.

When the ship had reached a point a few miles above Mount Vernon the gun was loaded as at the two previous discharges. The surgeon had distributed cotton around for plugging up the ears and the crowd had been instructed to open their mouths wide to equalize the pressure on the ear drums. Nothing appears to have been neglected to insure comfort and safety.

Captain Stockton, with one foot on the bed of the gun, gave his usual order to stand clear of the gun. The breech of the gun being at its greatest elevation, the lock was cocked and set to rolling motion at an elevation of 3°, the lock being self-acting; a cord was then passed around the wheel attached to the crank of the elevating screw used for the purpose of imitating the rolling motion of the sea, and manned. By hauling upon this cord, the muzzle of the gun was depressed to the point of elevation at which the lock was set, when instantly the cap burned and the charge exploded. Senator Benton vividly relates:

> I saw the hammer pulled back—heard a tap—saw a flash—felt a blast in the face, and knew that my hat was gone: and that was the last that I knew of the world, or of myself, for a time, of which I can give no account. The first that I knew of myself, or of anything afterwards, was rising up at the breech of the gun, seeing the gun itself split open—two seamen, the blood oozing from their ears and nostrils, rising and reeling near me—Commodore Stockton, hat gone, and face blackened, standing bolt upright, staring fixedly upon the shattered gun. I had heard no noise—no more than the dead. I only knew that the gun had bursted from seeing its fragments. I felt no injury, and put my arm under the head of a seaman, endeavoring to rise, and falling back. By that time friends had run up, and led me to the bow—telling me afterwards that there was a supernatural whiteness in the face and hands—all the blood in fact having been driven from the surface. I saw none of the killed: they had been removed before consciousness returned. All that were on the left had been killed, the gun bursting on that side, and throwing a large fragment, some tons weight, on the cluster from which I had been removed, crushing the front rank with its force and weight. Mr. Upshur, Secretary of State;

Mr. Gilmer, Secretary of the Navy; Commodore Kennon of the Navy; Mr. Virgil Maxcy, late United States chargé d' affaires at the Hague; Mr. Gardiner of New York—were dead. Eleven seamen were injured, two mortally. Commodore Stockton was scorched by the burning powder, and stunned by the concussion; but not further injured. I had the tympanum of the left ear bursted through, the warm air from the lungs issuing from it at every breathing. Senator Phelps and the young lady on my right had fallen inwards towards the gun, but had got up without injury. We all three had fallen inwards, as into a vacuum. The President's servant (I. More, colored), who was next me on the left, was killed. Twenty feet of the vessel's bulwark immediately behind me was blown away. Several of the killed had members of their family on board—to be deluded for a little while, by the care of friends, with the belief that those so dear to them were only hurt. Several were prevented from being in the crushed cluster by the merest accidents—Mr. Tyler being called back—Mr. Seaton not finding his hat in time—myself taken out of it the moment before the catastrophe. Fortunately there were physicians on board to do what was right for the injured, and to prevent blood-letting, so ready to be called for by the uninformed, and so fatal when the powers of life were all on the retreat. For myself, I had gone through the experience of a sudden death, as if from lightning, which extinguishes knowledge and sensation and takes one out of the world without thought or feeling. I think I know what it is to die without knowing it—and that such a death is nothing to him that revives. The rapid and lucid working of the mind to the instant of extinction, is the marvel that still astonishes me. I heard the tap—saw the flash—felt the blast—and knew nothing of the explosion. I was cut off in the inappreciable point of time which intervened between the flash and the fire—between the burning of the powder in the touch-hole, and the burning of it in the barrel of the gun. No mind can seize that point of time—no thought can measure it; yet to me it was distinctly marked, divided life from death—the life that sees, and feels, and knows—from death—for such it was for the time, which annihilates self and the world.

Another eye witness relates:

The scene upon deck may be more easily imagined than described, nor can the imagination picture to itself the half of its horrors. Wives were widowed in an instant by the murderous blast! Daughters smitten with the heart-rending sight of their father's lifeless corpse. The wailing of agonized females, the piteous grief of the unhurt but heart-stricken spectators, the wounded seamen borne down below! The silent tears and quivering lips of their brave and honest comrades who tried in vain to subdue or to conceal their feelings! What words can adequately depict a scene like this? The only circumstance calculated to relieve the all pervading distress is that of the multitude of the tender sex, who were on board, not one was injured. The scene of devastation did not for a minute put aside perfect order and discipline. The flag had been half-masted

immediately, the leadsman in the chains was calling out in his usual sing-song tone and every man was at his station immovable.

Philip Hone in his diary says:

There were two hundred ladies on board; but fortunately they were all below dining and drinking toasts. The noise of mirth and joviality below mingled with the groans of the dying on deck. By this circumstance they were saved. Not one of the ladies was injured. But, oh, the anguish of wives and daughters on the sight of the mangled remains of their husbands and fathers. Nothing so dreadful has ever happened in this country except the shipwreck of the *Rose-in-Bloom* and the conflagration of the Richmond Theater. This murderous gun, called the "Peacemaker," most deplorably earned its name, by making in an instant, the *peace* of several of the most distinguished men of the country and sending them "where the wicked cease from troubling."

Lieutenant E. R. Thomson, first lieutenant, enters in the log that fatal day:

The gun bursted at the breech, breaking short off under the trunnion band, one-half of the breech passed over the starboard bow carrying some twenty feet of the hammock netting and twelve hammocks, and the other half (piece weighing about 2,000 pounds) fell in the starboard gangway. Ten feet abaft the forehatch the breech pin struck and damaged slightly the starboard forward carronade slide, the "Peacemaker" carriage was a complete wreck. By that part of the gun which fell inboard with several fragments great injury was committed to the spectators and crew.

To the President, the pain of this awful event amounted to agony; he dramatically relates:

The crowd below is in utter ignorance of what is passing above. A loud report is at length heard, and does not, at the moment, arrest the song and merry jest. A mysterious whisper at last reaches the crowd: anxiety, to be soon succeeded by dismay, prevails. The upper deck is reached, and there lie sealed in death and already wrapped in the folds of that flag which was never looked upon by them while in life without imparting to their patriotic hearts a quickened pulsation, the two eminent secretaries and three other distinguished citizens, one of whom, also a son of this commonwealth, Commodore Kennon, had so often courted danger on the ocean, and had won the commodore's flag by gallant service, and at the time presided over an important bureau. While Virginia mourns over the remains of her noble sons, Maryland bends in solemn woe over her gifted Maxcy, and New York laments the death of her talented and accomplished Gardiner.

Joy is turned into mourning. The morning, so bright and cloudless, is succeeded by an evening of deep gloom and sorrow. The muffled drum, the solemn toll of the bell, the loud and dismal peal of the minute gun announce to the country the sad tidings of death and woe. There are two

vacant seats at the Cabinet board the following morning—Upshur and Gilmer have fallen, like two stars struck from their spheres.

Miss Julia Gardiner says:

I was with my father when a gentleman came to me and said, "Miss Gardiner, the President wishes to take you in to the collation which is just served." "I suppose I will have to obey orders," I replied with a laugh, and asking my father to follow me, I started down. Just then the wind caught my veil and blew it up. Father caught it with his cane and brought it down, saying, "Take care of your streamer." They were almost the last words I ever heard him speak. When we got down, the President seated me at the head of the table with him, and he handed me a glass of champagne. Father was standing just back of my chair, so I handed the glass over my shoulder, saying, "Here, Pa." He did not take it, but he said, "My time will soon come." He meant his time to be served, but the words have always seemed prophetic to me. That moment some one called down to the President to come and see the last shot fired, but he said he would not go as he was better engaged. My father started with some gentlemen. . . . Just then we heard the shot and the smoke began to come down the companionway. "Something must be wrong," I said to the young man [sitting on the other side of her], and he started up to see. He got to the door, and he turned around and gave such a look of horror that I shall never forget it. That moment I heard some one say, "The Secretary of State is dead!" I was frightened and I tried to get upstairs. "Something has happened. Let me go to my father!" I cried, but they kept me back. Someone told me that there had been an accident, the gun had exploded, but that there was such a crowd that it would do no good for me to try to get there. I cried that my father was there and I must learn his fate. I was told then that he was wounded. That drove me frantic. I begged them to let me go and help him; that he loved me and he would want me near him. One lady, seeing my agony, said: "My dear child, you can do no good. Your father is in heaven." I fainted and did not revive until some one was carrying me off the boat, and I struggled so, that I almost knocked us both off the gang-plank. I did not know at the time, but I learned afterwards that it was the President whose life I almost consigned to the water.

What of Captain Stockton? American naval history recalls no more pathetic picture. Just at the moment when his patriotic zeal, scientific research, and high hopes seemed to have reached a climax, he stands wounded, bewildered, and stunned amid a scene of indescribable horror wrought by the offspring of his ambitions—a living tragedy among the dead!

The *Princeton* came to off Alexandria at 4:20 and sent ashore for additional medical aid. The *I. Johnson* came alongside and received all the company except the President, Secretary of War

Wilkins, and such naval officers and other friends of the deceased as were appointed to care for the remains. At 8:10 P. M., the President left the ship by the steamer *Phœnix*. The steamer *I. Johnson* returned and received on board nine wounded seamen for transfer to the naval hospital at Washington.

The news of the catastrophe was received in Washington with astonishment and high excitement, the dismay of the people was mingled with intense curiosity to know the details. All night long immense crowds visited the wharf. The electric telegraph not having been inaugurated, the intelligence was slowly disseminated throughout the land by express train, post coach, and courier.

Preparations were made for transferring the dead next morning from Alexandria to Washington. A large number of people crowded the shores as the boat approached the landing place. "Six hearses in horrid contiguity stood side by side to receive the sad freight." Following the hearses to Washington were sixty carriages. At the request of the President, the bodies were brought to the White House with due solemnity and placed in state in the east room. With one exception, the faces of the deceased were exposed to the public view, "covered, however, with plates of glass."

On February 29, the President addressed a message to Congress announcing the death of Secretaries Upshur and Gilmer, expressing great grief that there should have been so suddenly stricken from his side two gentlemen upon whose advice he confidently relied in the discharge of the arduous task of administering the office of the Executive Department, and, whose services at this interesting period were of such vast importance.

The last paragraph of this message was quite remarkable, tortured as the President was with anguish over the loss of close personal friends, and sheds light upon his loyal character and faith for the future.

> In some relief of the public sorrow which must necessarily accompany this most painful event, it affords me much satisfaction to say that it was produced by no carelessness or inattention on the part of the officers and crew of the *Princeton*, but must be set down as one of those casualties which, to a greater or less degree, attend upon every exercise, and which are invariably incident to the temporal affairs of mankind. I will also add, that it in no measure detracts, in my estimation, from the value of the improvement contemplated in the construction of the ***Princeton***, or from the merits of her brave and distinguished commander and projector.

Congress adjourned in respect for the memory of the late distinguished secretaries and manifested its sympathy for the bereaved families by attending the funeral in a body. The badge of mourning was worn for thirty days by all members and copies of resolutions were communicated to the President of the United States and to the families of Mr. Upshur and Mr. Gilmer.

The funeral took place from the East Room of the White House at 11:00 A. M., Saturday, March 2nd. By proclamation of the mayor, all business was suspended during the funeral and, although market day, the streets were silent and in gloom, though a mass of humanity. Places of business were draped and the funeral procession presented an imposing *coup d'œil*. The adjutant general of the Army was in charge of the military arrangements; after the caissons came organizations in the following order: volunteer troops; U. S. Marines; squadron of U. S. cavalry; troop of U. S. light artillery; dismounted officers of the marine corps, the Navy, and the Army in order named; civic organizations. Out of sympathy for Captain Kennon, one time commandant of the Navy Yard, Washington, a delegation of navy yard mechanics attended in a body. To the tolling of the bells of Washington, Georgetown, and Alexandria, the long funeral cortège proceeded slowly to the Congressional Cemetery. Minute guns were fired by artillery stationed near St. John's Church and city hall and at the navy yard. At the cemetery taps were sounded by a bugler and volleys fired.

The remains were deposited in a large public receiving vault from which they were later removed and conveyed to their homes by families of the deceased.

Shortly following this melancholy event, Captain Stockton submitted to the President a request that a judicial inquiry be instituted into the conduct of himself and officers in relation to the experiments and proofs which preceded the construction, and the proofs and explosion of the great gun. This request the President was pleased to grant observing that he entertained the most perfect confidence that no censure could, with any show of justice, be imputed to either of the parties, but yielded to Stockton's request only as an act of justice to him.

A naval court of inquiry was ordered to convene aboard the *Princeton* on Thursday, March 7, constituted as follows: President,—Captain William C. Bolton, U. S. Navy; member,—Cap-

tain Isaac McKeever, U. S. Navy; member,—Captain John H. Aulick, U. S. Navy; judge advocate,—Richard S. Coxe, Esq. Captain Bolton, it will be remembered, was an eye witness to the disaster. Mr. Coxe was a civilian lawyer.

On the second day the court met at Fuller's Hotel, Washington. Captain Stockton was unable to attend in person, not having sufficiently recovered from his wounds, but was represented by Mr. John R. Thomson of New Jersey, counsel. Stockton, in a letter to the court, written from the Gadsby's Hotel, said "I desire most earnestly that every act of mine in relation thereto, from the first moment that I suggested the plan of the guns up to this time, may be spread upon the record of the court, without regard to any technical niceties."

The first witness was Mr. Francis B. Ogden, an iron expert, who discussed with Captain Stockton in London in 1839 the idea of the practicability of manufacturing large guns of wrought iron. He testified that William Young, manager of the West Point Foundry, and Captain John Ericsson were also present and all agreed that if it were possible to weld together so large a mass of iron, a gun so constructed, from the superior strength of the material, would possess advantages that could be obtained in no other manner. Witness asserted that the metal of the "Peacemaker" was the largest mass that was ever brought under a forge hammer, and that examination after the explosion showed "the fibrous quality of the iron appears to be wholly destroyed; large crystals form the mass; and the specific gravity is found to be nine per cent less than that of ordinary hammered iron."

Other witnesses called were Lieutenant William E. Hunt, U. S. Navy, who aided Captain Stockton at Sandy Hook in mounting and proving the gun and was the officer in charge at the explosion; Gunner Robert S. King, U. S. Navy; various members of the gun's crew and finally Captain Bolton who was called to testify as to the conduct of the officers and crew. A letter from Colonel George Bomford, U. S. Army, ordnance expert, to Captain Stockton was introduced to show that Stockton solicited expert opinion concerning the proper proof of large caliber guns.

On March 11, the court adjourned with the following findings:

1. That in the year 1839, Captain Stockton being in England, his attention was attracted to the extraordinary and important improvements which had recently been introduced into the manufacture of large masses of

wrought iron, as a substitute for cast iron, for objects which required a combination of strength and adhesiveness or toughness. Large shafts for steam engines had thus been fabricated, which experience has demonstrated to be superior, in those qualities which were desirable, to the same articles manufactured of cast iron.

These circumstances appear to have led Captain Stockton to consider the question how far the same material might be employed in the construction of cannon of a large caliber. He appears to have been animated by motives the most patriotic—stimulated by the laudable desire of being himself instrumental in promoting the honor of his country, and of elevating that branch of the service with which he was personally connected. To what extent his inquiries were carried, the court has not been advised; but it is in evidence that he did advise and consult with three gentlemen possessing, from their scientific acquirements and practical experience on such subjects, very superior qualifications in questions of this character, and whose opinions were entitled to high respect. Mr. William Young, Captain Ericsson, and Francis B. Ogden, Esq., are the gentlemen to whom allusion is made. After much deliberation and several consultations, with calculations furnished from the same quarter, Captain Stockton determined upon the construction of a gun of the proposed dimensions, for the purpose of testing the opinions of scientific men by the results of experience. A cannon was accordingly made at the Mersey works, of Yorkshire iron, which, being approved of, was shipped to the United States. Having been properly prepared for the purpose, this gun was carried to Sandy Hook, and subjected to what was deemed the proper test. After the first firing, preparations were made to mount the gun; in doing this, a crack was perceived opposite the chamber, which induced Captain Stockton to have the breech strengthened by putting bands around it. These bands are represented as being 3½″ in thickness. With this additional strength given to the defective part of the gun, the experiments were renewed, and the result was a decisive conviction upon the minds of all connected with them, that, in general, the anticipations of Captain Stockton were perfectly realized; and, secondly, that if a gun of this construction should yield to the force of the trial, it would be by a simple opening, and not, as in cast iron, a violent disruption and scattering of the fragments. The success of these experiments was such as to decide Captain Stockton forthwith to direct the construction of another gun of a similar character, to be made of American iron, which is usually regarded as superior in strength and tenacity to the English iron. This second gun (the same which exploded on board the *Princeton*) was constructed with a chamber similar to that of the first gun, with an additional thickness of 12″ at the breech—a difference (even if the metal were only of equal goodness) far more than sufficient to compensate for the bands by which the first had been fortified.

Application was made to Colonel Bomford, of the Ordnance Department of the Army, who, it is well known, has been professionally occupied in experimenting upon guns of a large caliber, and his opinion requested as to the proper proof to which such a gun ought to be subjected. The

proof suggested by Colonel Bomford as a suitable one will be found in his letter of November 25, 1840, appended to the record. The new gun constructed by order of Captain Stockton, exceeded in dimension and weight, consequently should have also surpassed in strength, that contemplated by Colonel Bomford; they being of the same caliber, and the proof to which this cannon was subjected was much more severe than what was proposed as sufficient by that experienced officer.

In view of all the circumstances thus briefly adverted to, but minutely detailed in the evidence which is spread upon the record, the court entertains a distinct and confident opinion that, in originally forming the plan for the construction of large guns, Captain Stockton proceeded on well established practical facts; that in coming to a decision upon the feasibility of the contemplated project, he did not rely upon his own theoretical opinions, but resorted to men of science and practical skill for advice; and that he was fully sustained by their judgment in every particular; that a series of experiments and trials with the two guns fully sustained the deductions of the gentlemen whose advice was sought, and justified the most assured confidence in the durability and efficiency of the gun.

In regard to the mode of loading and firing on every occasion, and emphatically that which was followed by the explosion, it is established by the fullest proof, to the entire satisfaction of the court, that every care and attention which prudence and professional capacity could dictate was observed. No shadow of censure, in this respect, can be attached to any officer or any of the crew of the *Princeton*.

In regard to the conduct and deportment of the captain and officers of the *Princeton* on the occasion of the deplorable catastrophe which occurred on the twenty-eighth of February last, the court feels itself bound to express its opinion that, in all respects, they were such as were to be expected from gallant and well trained officers sustaining their own personal character, and that of the service, marked with the most perfect order, subordination, and steadiness.

In conclusion, the court is also decidedly of opinion, that not only was every precaution taken which skill, regulated by prudence, and animated by the loftiest motives, could devise to guard against accident, but that Captain Stockton, Lieutenant Hunt, and Mr. King, the gunner, who had attended to and directed all the experiments and trials of these guns, exhibited only a due confidence in what they had witnessed, in placing themselves on every occasion, and particularly on that of the explosion, almost in contact with the gun, and in a position apparently not only more dangerous than any other, but that which might rationally have been deemed the only perilous situation on board the vessel.

The court, having thus completed its business, adjourned *sine die*.

March 11, 1844.

W. C. Bolton, *President*
Richard S. Coxe, *Judge Advocate*

The House of Representatives on March 23 passed a resolution calling upon the Secretary of War and Secretary of Navy to in-

form the house what experiments had been made by officers of their respective departments for the purpose of testing the strength and utility of cannon made of wrought iron; also what experience the European powers had on the subject.

It appeared that the only experiments for the purpose of testing wrought-iron guns made by the Army was the trial of two 6-pounder guns at Washington and Watervleit Arsenals in 1832. At Watervleit, after firing forty-two rounds, the gun remained serviceable but the enlargement of the bore was found to be .04" which was more than double that of bronze guns then made. The test of the gun at Washington left the bore in a condition unfit for service by opening the seams and welds. From these tests, it was concluded that wrought-iron guns were not fit due to the difficulty in welding the parts together perfectly and the still greater difficulty of ascertaining whether the welds were perfect or not.

The Navy had had no previous experience with wrought-iron guns and it developed that the use of wrought-iron for cannon had been attempted in Europe repeatedly but without success. Myers, in his work entitled *Experiments in Fabrication and Durability of Cannon Both Iron and Bronze,* edition of 1834, says "it is certain no experiment in artillery has been as often unsuccessfully repeated and abandoned as the fabrication of wrought iron cannon."

On May 15, 1844, the house committee on Naval Affairs sustained the action of the Court of Inquiry in their findings that no blame was attributable to the officers and men on duty at the time, but they sounded a note of censure. They reported that these large guns were bought by Captain Stockton without any express order from the Navy Department and that the building of the *Princeton* and the procurement of her armament were under his direction. The committee found that no proper officers of the government had anything to do with the gun except to direct purchase and agree to pay the bills. They learned that the construction of the *Princeton* was not supervised by officers of the government charged with that branch of the public service. Everything seems to have been left with Captain Stockton "enabling him to carry out his own peculiar views."

These guns were not ordered originally by the advice of the ordnance department of the Navy, as would seem to be the proper course, that being the branch of the service instituted by

law for the regulation of naval armament, and they considered it irregular "to permit an officer unconnected with the construction or ordnance department to proceed with so little restraint in the building and arming of a ship of war."

The committee further felt bound to express the opinion "that an unusual species of armament attended with danger should not be introduced into public service until it receives the full approbation of the ordnance officers as to its efficiency and safety."

They trusted that:

> the sad event which has given rise to this investigation and the information elicited by this inquiry from intelligent ordnance officers, will lead to cautious proceedings in a matter of such importance to the success and reputation of the Navy, and one in which the lives of those engaged in the public service are so deeply concerned. The committee ask to be discharged from the further consideration of the subject.

It appears that the President approved the report of the court of inquiry and that no action was taken against any person connected with the accident. The final chapter to the whole sad business came in a letter from the President to the Secretary of the Navy, as follows:

> Washington, March 14, 1844.
>
> Being entirely satisfied, from the report of the late court of inquiry, that no vestige of pretense remains to visit the slightest censure on the officers and crew of the *Princeton*, either collectively or individually, for the sad and melancholy accident which has occurred on board that ship; and regarding the bursting of the gun as one of those incidents which have often before attended the use of cannon of every size and description; and being firmly impressed with the great importance of the *Princeton* as a ship of war, it has therefore seemed to me to be altogether proper to direct the construction of another gun of the size and dimensions of that lately destroyed.
>
> I have, therefore, thought proper to order that such a gun be wrought, under the direct supervision of Captain Stockton, as soon as may be; and that the same be paid for out of any unexpended balance remaining of the appropriation for navy ordnance.
>
> To the Secretary of the Navy. JOHN TYLER

In a development of arms a naval officer has always had to deal with high explosives and unknown quantities. It is inevitable that from time to time accidents occur. The attitude of President Tyler doubtless was an inspiration to the naval officers of that day. His was not blind faith but far-sightedness. The work goes on.

THE AERONAUTICAL BOARD OF THE ARMY AND NAVY

By Major Jarvis Butler, O.R.C., U. S. Army
Secretary Aeronautical Board

THE late Captain Nathan Sargent, commanding U. S. S. *Baltimore,* in accepting the gunnery trophy awarded to that ship, gave all credit to "the officer behind the man behind the gun." In the training, coordination of the many factors entering into necessary teamwork, and the administration of a complex organization, much credit is due at that point.

Equally essential to effective development and employment of modern forces of the air is the coordinating authority behind those elements of the Army and Navy. With missions totally different, requiring highly specialized training along equally different lines, the fundamentals involved are nevertheless identical and afford a common ground relationship in respect to the development of the science and expenditure of effort.

Cooperation and coordination have been provided for. Perhaps more attention has been directed to this subject, due to the sensational development and picturesque activities of aviation, than in the case of any new weapon in modern times. Each new instrument of warfare, in its turn, has had proponents to advocate separation and exclusive specialization. The advent of the submarine, in particular, brought forth proposals for a separate and distinct submarine service and almost every branch of the Army and Navy has had loyal enthusiasts advocating varying phases of special consideration from favored position to abolition of all other arms. Only a few years ago a well known officer of the Army, recently of the air service, admitted that cavalry had at last come into its own and, because of its mobility and efficiency, declaimed the end of the artillerist and infantryman.

After each war the prediction has been freely made that the next would be fought differently. We heard a few years ago that with the highly developed long range guns, the next war would be an artillerists' duel, that opposing forces would rarely see each

other. Battleships, and later submarines, were likewise to be the answer to all conflict. But we still have infantry, artillery, the battleship, and the submarine. Weapon begets weapon. Just as the destroyer was the answer to the torpedo boat, the answer to air attack is air force.

The broader vision of the responsible heads has kept a balanced Army and Navy and caused definition of the rôle of all elements in the ultimate mission of the armed forces. No arm has been relegated to the scrap pile; each still has its mission to perform as a part of the national defense.

The air force, then, is a component part of the national defense machine. It has a varying relation to each other part, and proper functioning requires an effective governor as in any other piece of machinery.

With the accomplishment of flight by heavier-than-air craft the relationship of aviation to the existing armed forces was recognized and problems arose which were met in the light of available information. These problems were multiplied with the rapid strides which immediately followed, and the Aeronautical Board was established to function as the needed governor.

Because of the far reaching influence of air force, this board includes a minority of non-flying members who are experts in the mechanics and tactics of the remainder of the machine as well as the larger subject of strategy. The board is charged with the development and employment of the army air service and naval aviation.

The first concerted effort in the development of the air forces followed a proposal of the Secretary of War in October, 1916, when a joint board of three army and three naval officers was formed to consider the development of a new rigid airship service. Related subjects very soon indicated the need of broader jurisdiction and the "Joint Army and Navy Board on Aeronautic Cognizance" was created. From time to time the Secretary of War and the Secretary of the Navy added new subjects to its jurisdiction.

The board as thus organized functioned during the World War and acted upon many questions such as the availability of localities for aeronautical purposes; the missions of army and navy aircraft; and the selection of insigna for marking United States aircraft. The President's proclamation of February 28, 1918,

added the power to grant licenses for war time operation of civilian aircraft.

After the armistice, the lessons of the World War led to the study of a definite policy for the development of aeronautics. Under a precept approved by the two secretaries on June 24, 1919, the study of such a policy was commenced and the name of the board was changed to the "Joint Army and Navy Board on Aeronautics" and later, to avoid confusion with The Joint Board, to "The Aeronautical Board."

Having finally adopted a "Policy of the Army and Navy relating to aircraft" which defines the functions and spheres of operations of army, navy and marine aircraft, the Aeronautical Board was reorganized and its jurisdiction made clear in an order signed by the Secretary of War and the Secretary of the Navy on June 17, 1924. This order provides that members of the board shall at all times include the chief of the Army Air Service, the chief of the Bureau of Aeronautics, their respective chiefs of training and planning divisions, and an officer of the war plans division of the General Staff and one of the corresponding divisions of the Office of Naval Operations. To preserve an even balance in membership the board has no president or chairman and a permanent civilian secretary is appointed jointly by the Secretary of War and the Secretary of the Navy. The senior officer present at each meeting presides, for parliamentary purposes only, and all reports of the board bear the signatures of the senior officer of each service present at the meeting at which such reports are adopted.

The present membership of the Aeronautical Board is as follows:

The Chief of Air Service, Major General Mason M. Patrick, A. C.

The Chief of Training and War Plans Division, Air Service, Major H. C. Pratt, A. C.

Member of War Plans Division, General Staff, Colonel Edward R. Stone, G. S.

The Chief of the Bureau of Aeronautics, Rear Admiral William A. Moffett, U. S. N.

The Chief of Planning Division, Bureau of Aeronautics, Commander N. H. White, U. S. N.

Member of War Plans Division, Naval Operations, Commander John H. Newton, U. S. N.

To accomplish its objective, the Aeronautical Board is required to investigate, study, and report upon all questions affecting jointly the development and employment of air forces of the Army and Navy. It is specifically charged with the duty of preventing duplication of effort, with providing "sufficiency and efficiency of cooperation and coordination," and with originating consideration of pertinent subjects and submitting recommendations thereon when, in its judgment, necessary.

In the execution of this mission, the precept (published in G. O. 132 July 7, 1924) requires:

(a) All recommendations of the Aeronautical Board affecting joint policies or joint plans for the tactical or strategical employment of aircraft or for the location of air stations, will be addressed to the Joint Board for consideration and recommendation to the Secretary of War and the Secretary of the Navy.

(b) The Aeronautical Board will formulate and submit to the Joint Board for approval, suitable joint Army and Navy aircraft problems to be carried out each year.

(c) The Chief of Air Service of the Army and the Chief of the Bureau of Aeronautics of the Navy will submit to the Aeronautical Board all questions which concern jointly the Army Air Service and Naval Aviation.

(d) The development of new types of aircraft, aircraft motors and aircraft accessories, or of weapons to be used from aircraft will, so far as practicable, be assigned to the Army or to the Navy and shall be carried on only by the service to which assigned. This restriction will not prevent the employment by either the Army or Navy of any types of aircraft or weapons which, after development, are considered to be necessary for the accomplishment of its functions. Questions relating to the development of new types of aircraft, aircraft motors and accessories or weapons to be used for aircraft will be referred to the Aeronautical Board for recommendation as to whether the Army or Navy shall be charged with the development.

(e) Whenever possible, training, repair, and other aviation facilities of either the Army or Navy will be made available for or be used by the other service.

The Aeronautical Board is specifically charged with the following:

(f) Plans to prevent competition in the procurement of material. Before arranging to purchase aircraft, each service will ascertain whether aircraft of the type desired can be obtained from the other service. Joint plans for procurement of material in time of war will be submitted to the Army and Navy Munitions Board.

(g) Consideration and recommendation of all projects for experimental stations on shore, for coastal air stations, and for stations to be used jointly by the Army and Navy, or for extensive additions thereto.

(h) Consideration of and recommendation in regard to all estimates of appropriations for the aeronautical programs of the Army and Navy before such estimates are submitted to Congress.

(i) Coordination of the activities of the Army Air Service and Naval Aviation in the purchase of material abroad and coordination of their activities with the aeronautical activities of other branches of the Government and with civilian aeronautical organizations.

(j) Recommendations as to action to be taken on invitations of foreign governments to participate in aviation activities abroad and on the invitations of civilian organizations to participate in such activities in the United States.

(k) Cognizance of the issuing of licenses to civilians to operate aircraft in time of war.

From the foregoing it will be seen that in aeronautical matters not directly involving other branches, or joint policies and plans, the action of the Aeronautical Board is final, subject only to the approval of the Secretaries of War and Navy.

In those cases in which concurrence of the higher military board is required, it may be interesting to note that twenty-three such cases have gone up to The Joint Board—which has no air officer a member—twenty of which have been approved; one approved except as to additional subject introduced; and two were amended and approved. All subsequently received the approval of the Secretary of War and Secretary of the Navy as passed by the Joint Board.

Reports and recommendations of the Aeronautical Board submitted direct to the two secretaries, as well as those required to pass through the Joint Board, have likewise received the secretaries' approval. This procedure is in accord with the traditional policy of subordinating the military organization to the civilian goverment. Action of the secretaries, and that of the Joint Board is an index to the confidence reposed in the cooperating agency of the military and naval air forces both by the civilian heads charged with the responsibility of the national defense, and by the military "high command" responsible to them for preparation and execution of plans.

Both military and naval authorities are fully aware of the important position which aviation has achieved as a military weapon. Members of the Aeronautical Board in their daily duties carefully observe and study development both at home and abroad and bring into the discussions of the board the most advanced thought on each subject. The participation of aircraft in all

recent army and navy maneuvers, as well as in the theoretical studies and war games of the Army and Naval War Colleges is likewise considered.

From such experience and studies the missions of aircraft are evolved, based upon sound premises and proved capacity. With the spheres of operations determined, the time of the board is occupied with furthering the development of aeronautics and avoiding unnecessary duplication of effort.

Cooperation is effected through such measures as the exchange of technical notes and reports on principal development work in aircraft and accessories conducted by the Army at the engineering laboratories of McCook Field and by the Bureau of Aeronautics; the similar interchange and discussion of contracts for aircraft material let by either the Army or the Navy, and of the reports of trial boards on acceptance tests of aircraft.

In the interest of economy and the avoidance of duplication, specialization in the development of particular types of aircraft, as well as certain accessories, has been assigned to one service or the other. And for the same reason the joint use of air stations, wherever practicable, is effected.

In the preparation of the annual estimates for each service, the first step is presentation of such plans and figures to the Aeronautical Board for the purpose of eliminating duplication.

The board's consideration of estimates for the fiscal year 1920-21 disclosed that each service included provisions for the establishment of a rigid airship hangar on the Pacific coast. In order that one might be properly eliminated, the question of the assignment of the development of rigid airships to one service was determined. Hearings gave opportunity to officers of the army and navy air services to express their views as to the present development of the rigid type of airship, its future possibilities, and related factors.

All investigations involve careful study from many angles. The conclusion that the Navy be charged with the development, procurement, and operations of rigid airships, for example, is predicated upon such considerations as the necessity for avoidance of duplication; the enormous expense entailed in the development, operation, and upkeep of the type; the necessity for the greatest economy; and important development steps already taken by the Navy. Other factors included the greater immediate need of the

Navy for the type and the fact that rigid dirigibles developed for naval purposes would be equally suited to army use.

The practical result of this illustration is more far-reaching than the mere edict that one service is charged with a particular function. Desired assistance by the service relieved is provided for while the benefit of experience and experimentation is saved to both.

The endeavor of the Aeronautical Board, therefore, is to facilitate development in the Army of the most efficient air service obtainable, both in personnel and material, making available to it, when practicable, development and other facilities belonging to the Navy; and to similarly assist the Navy in providing the most efficient air service attainable, within limitation only as imposed by Congressional appropriations. In its consideration of methods and means to this end, the conclusions reached are actuated by interests of efficiency, economy, eliminating duplication of effort, and providing for the joint use of facilities whenever practicable.

The precept of the Aeronautical Board, set forth above, indicates that there exists today machinery for advising upon the effective and economical development and use of aeronautics to the fullest extent of its capabilities as an element of the national defense. The precept expressly contemplates cooperation with civilian effort in advancing the science. This feature alone is of vital importance, for every step in the development of civilian aeronautics increases the resources available for national defense and at the same time is most desirable as a peace time commercial activity. With our national resources, industrial organizations, great distances, and other factors, commercial aviation in the United States can, if it will, lead the world.

SOME WHYS AND WHEREFORES OF POWER

By Lieutenant E. B. Perry, U. S. Navy

ONE bright spring morning the United States Battle Fleet lay in the North River, resplendent in all of the glory of fresh paint and sun-bleached decks. All halyards were taut; the colors properly two-block; searchlights and ventilators trimmed fore-and-aft; not an Irish pennant was to be seen; barely a trace of smoke was visible at the stacks. It was a picture to delight any seaman's eye. On the dock, waiting for one of the ship's boats, were two men; one a naval officer and the other an engineer of some repute. With a pardonable pride the naval officer pointed out his ship and asked his companion what was his impression of her as she lay there, silhouetted against the Jersey shore. Imagine his dismay when his friend answered: "Well, it looks to me like a damn big ship with holes all along the side and water coming out of every one of them."

Unfortunately this has been the viewpoint of many well-meaning engineers familiar with land practice, who knew little or nothing of the problems confronting the engineer in marine service, particularly the naval service. They point with pride to the latest development in the public service central station field, where money is rightfully being spent to catch the last, reluctant, little heat unit, and contrast the equipment and performance there with that of a ship, with little thought to the diversity of purposes for which the two plants were built.

The central station man may rightfully be proud of the achievements in that field within the past ten years and look forward to an even brighter future. Let us examine some modern generating plants and see just what is present practice. We will also be interested to see to what extent that practice would be applicable to the power plant of a ship, and particularly a naval vessel.

First, let us realize that there are two types of plants ashore; those in which no expense has been spared to conserve every possible B. T. U., new designs and ideas being adopted freely and

conservatism thrown to the winds in the effort to bring down the fuel bill even though the fixed charges be high; and others where economy is courted rather than manhandled, first cost being the criterion as to the equipment to be installed and then much thought given as to the best means of operating for highest economy. The controlling motive behind each plan is the same; to turn out a kilowatt hour for the lowest possible expenditure. It will be understood that location, type of load, construction costs, and labor available may make one type of plant desirable in one locality while the other, which seems so diametrically opposed to it, may be the logical selection elsewhere.

As a concrete example of the conservative type of plant let us see what the Public Service Corporation of New Jersey is doing in their new Kearny station. Our interest will center in the boiler plant, main turbines, condensers, and auxiliaries, all of which are more or less common to the plant of a ship. The ultimate capacity of that plant will be 410,000 KVA at 80 per cent power factor. There is at present installed, in five units, three General Electric 39,200 KVA turbo-generators and two Westinghouse 43,750 KVA units. Each is designed for 325 lbs. per sq. in. steam pressure with 271° superheat at the throttle. They generate at 14,200/13,200 volts, 3-phase, having two-circuit windings, differentially protected between circuits and between phases. A closed system of ventilation is used for the generators but no particular provision is made that this air shall be initially cleaned. Each generator carries a direct connected exciter. The turbines are each mounted on individual foundations, separate from the main floor of the turbine room.

The turbine room, then, offers nothing particularly new or startling. The steam pressure is only medium, a high degree of superheat is carried and the generation voltage is one favored ashore where there is plenty of room for phase isolation. The practice of employing the closed ventilation system is one that most navy men will recognize as an old friend.

The condensers are directly below the turbines and are a part of them, resting on massive coiled springs to relieve the turbine castings of their weight yet give freedom of movement in any direction. There are installed two Allis-Chalmers, two Westinghouse and one Wheeler Condenser & Engineering Company surface condensers with 50,000 sq. ft. of tube surface each. Here

we do find something different; the condenser as a part of the turbine. More will be said of this feature of the plant later.

The auxiliaries are electrically driven, 2,300 and 440-volt A. C. motors being used for the purpose. Certain of the more important auxiliaries are duplicated in turbine-driven emergency apparatus.

Both the open and the closed type of feed water heaters are installed, heating being obtained by turbine bleeding. This scheme is not new to stationary practice (nor marine) and a typical example will be given in a later section.

The feed water is chemically treated, a practice which is going out of style with the installation of apparatus to purify the feed and degasify the water. In this particular, then, we find this new plant trailing along with the average run of plants both ashore and afloat.

The boiler plant is composed of a battery of twelve Babcock & Wilcox, 2,360 B. H. P. boilers fired by Riley and Taylor underfeed stokers. The boilers are equipped with inter-deck superheaters but neither economizers nor air pre-heaters are in use. Both induced and forced draft are in use. Here again we find a contrast to the marine type of boiler, for the high boilers used in this plant would take at least three decks head-room in a ship. Also, this plant uses crushed coal as a fuel while the battleships of the navies of the world are almost without exception fired by fuel oil.

In short, this Kearny station is the sort of plant that the average engineer would recognize as typical, being a little larger in rating than many, but practicing the same economies and exercising the same care, on a magnified scale, that we have come to expect from a central station plant. There is nothing extreme about it but most of the devices available for securing high economy have been employed. As a proof of economy, the expected average B. T. U. per kilowatt hour for this plant is 16,500 and that is now being approximated.

For the other type of plant, where every effort has been made to bring the average B. T. U. per kilowatt hour down by designing with that as the particular object, the Edgar station of the Edison Electric Illuminating Company of Boston might be chosen as an example. In this plant we find the steam pressure boosted up to 1,200 lbs. per sq. in. with a temperature of around 700° F.

The boiler plant consists of a single boiler of approximately 17,000 sq. ft. heating surface, with unit economizer. The boiler is of the cross-drum, vertical header type, forty-eight tubes wide and seventeen tubes high, fired by a sixteen retort underfeed stoker. The economized surface is sixty-six per cent that of the boiler surface. This boiler delivers steam to a 3,150 KW turbo-generator which expands to a re-superheater, located in the boiler, and thence to the main steam header, which is carried at 350 lbs. per sq. in. pressure. The high pressure section of the plant will

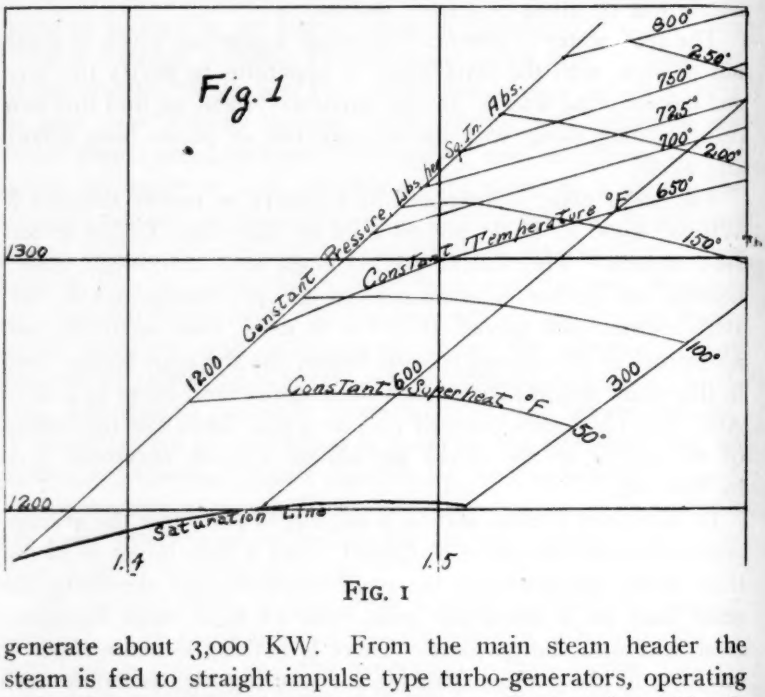

FIG. 1

generate about 3,000 KW. From the main steam header the steam is fed to straight impulse type turbo-generators, operating at header pressure and 700° temperature. Each main turbine is 32,000 KW and drives a 30,000 KW at 80 per cent power factor generator.

This installation, it will be seen, does not conform to the accepted type. The high pressure boiler necessitates a very special design. A great deal of experimental work has been done to develop this boiler. Pipe lines and fittings each offered its particular difficulty to be overcome. The steam tables did not cover the range above 800 lbs. per sq. in. so that further work had to

be done on the very properties of steam in order to know just what to expect of this sort of plant.

As a matter of general interest, a section of the extended steam tables in the form of the Mollier diagram is given in Figure 1. This chart will show why it has been found necessary to employ two turbines for the complete expansion, for the steam is beginning to get decidedly wet at around 300 lbs. per sq. in.

In these two stations we have examples of what the people ashore are doing; how can we apply them to marine service? Is engineering afloat so far astern of the practice on land?

In order to answer these questions with any degree of certainty it will be necessary to examine each piece of apparatus separately after having studied the characteristics of its class. The decision on any one particular machine or unit of a class will probably be governed by the particular conditions of the job to be done.

A logical place to begin such a study is in the boiler room, and there with the boiler itself. The question might be asked, "What is a boiler anyhow?" By definition, it is a "strong metallic vessel in which steam is generated for engines and other useful purposes." Many boilers are just that: strong metallic vessels. They should be a great deal more than that. A boiler must be the combination of a *furnace* in which heat may be properly generated from whatever fuel is at hand, and of a *heating surface* which will absorb that heat, the whole working to get the greatest number of B.T.U.'s per pound of fuel fired.

Therefore we find that the boiler problem, alone, is a series of steps, the first being the means whereby the aims of the boiler may be carried out, and the second the effectiveness of the means.

In common with everything else in this age of forced, fast living, the boiler must be capable of rates as high as practical within the limits of high efficiency. We must never let efficiency escape from our sight even for a moment, unless there be a very good reason for its sacrifice. There are reasons for accepting a lower efficiency, as we shall find later.

Since the boiler is to be capable of evaporating a great many pounds of water per hour, it must be able to burn a whole lot of fuel per hour, and that in a limited space with the least possible loss, the limiting condition being that there shall be no undue damage to the structure of the boiler. Some damage must be expected and allowed for; there must be a balance between de-

terioration with its consequent upkeep costs and the initial investment in materials and space, coupled with the efficiencies of operation under various conditions of service. In short, the boiler must be able to receive great quantities of fuel and burn it with little loss: the ratio of heat obtained and heat available must be high.

Having obtained a great amount of heat, the next problem is one of absorption. The fuel having been burned and a great amount of heat set free, it is then the function of the heating surface to absorb that heat with as little loss as possible. The limiting conditions here are those of temperature and of pressure. The temperature is limited by the metals employed, that limit today being about 750° F, while the pressure is that best suited for the engine in which the steam is to be used, generally a turbine. This absorption by the heating surface must be accomplished with the least possible loss and with as little weight and space as possible. The ratio of heat absorbed and heat available must be high.

Our first conception of a boiler, then, becomes that of an efficient furnace and an efficient heating surface. The furnace may be designed to burn any sort of fuel and the heating surface should be capable of being used over any sort of furnace.

A logical division of furnaces would appear to be according to the fuels ordinarily burned. Such a classification would include: (a) coal, hand-fired (b) coal, stoker-fired (c) coal, pulverized and blown into boiler (d) fuel oil.

A coal, hand-fired furnace requires a grate, an opening and firing, a means of getting rid of ash, a means of breaking up the fires and getting rid of clinker, an air control, and is absolutely dependent upon the skill and strength of the fireman as to its efficiency, or inefficiency. Doors must be frequently opened, allowing the cold air of the fireroom to rush in and mix the products of combustion, cool the furnace and fuel bed, and generally disturb conditions inside the furnace. It requires little vision to see that it would be very nice to do away with hand firing entirely, if such were possible.

Coal, stoker-fired, is another problem. The stoker is a feeder, proportioner, mixer, and pre-mixer. It is automatic, simple, and efficient. Coal is fed into the furnace at a given rate, is continually broken up and moved about, and finally goes over to the

ash pit as ash; practically all of the combustible having been liberated in its travel through the furnace. There is no opening of doors, no non-uniformity of feed, nor is there any muscular strength or skilfulness of a fireman as a factor in the operation. Means are provided for the proper control of the air and, once established, conditions can be duplicated at any future date. In other words, the operation can be calibrated for the best results, and after that it is merely a matter of setting to duplicate the results.

The pulverized coal system is coming into wider use due to the fact that any sort of coal can be pulverized and burned. The powdered coal is blown into the furnace in what approximates a fine oil spray, mixes with the necessary air and is burned. Contacting destroys the flotation of the dust. Ash is set free due to the gasification of the coal. It is molten or fixed at contact and set free, tending to build up a slag lump. To be rid of such a slag lump, the bottom of the furnace is cooled, the feed generally being downward, and there are deposited granular chilled particles of slag. If the furnace be deep enough, the dead gases at the bottom act as a cooler. Sometimes tubes are installed in the furnace bottom to achieve this result. The danger of the formation of a slag lump thus puts a burden on the furnace, that of providing a cooler.

Fuel oil burning approximates gaseous fuel if the spray be fine enough. It requires a system of piping to bring the fuel to the burner, a means of ejecting the oil into the furnace in a fine, whirling spray, a means of mixing the whirling oil spray and the air necessary to burn it, and a means of mixing and re-mixing the spray and gases until all of the combustible has been burned. A change in the load must be met by instantaneous change in the oil feed as well as in the air feed, so that new settings are necessary every time there is a load change. Further, the fuel temperature must be under careful control. The fuel spray must not be allowed to hit upon the furnace walls, boiler tubes, or any other surfaces or there will be a lump of carbon formed. This necessitates a careful setting of the burner pipes in the cones, determined by the shape and angle of the cones.

For any sort of fuel, as the combustion rates go up, and particularly as we go up in furnace size, the wall problem becomes severe. For a given volumetric rate, walls four feet apart will

not give as much trouble as walls twenty feet apart. There is much more radiation in the first case than in the second. With coal fuel, the refractory question becomes one of flux, with oil it is a case of melting or of chemical reaction. This means that the wall must be selected with reference to the nature of the ash and the maximum temperature. Hollow walls with air circulating through the passages to cool the walls and pre-heat the air are in use. This is a regenerative process and a clear gain and has led to the installation of pre-heaters. With air pre-heaters in use, however, the furnace problem becomes more and more severe due to that very gain in heat. Wall screens of generating tubes, some with fins and more without, are in use as protectors. They soak up an enormous amount of heat as compared with the rest of the boiler and thus keep the walls much cooler. In the same line, many furnaces are fitted with wall superheaters, generally in the back wall, eliminating a section of that wall.

There are two types of arch in use, one being the Detrick brick arch, held in place by a metal key, the other the use of boiler tubes on which are placed the arch brick.

As a last step in boiler efficiency, affecting both the furnace and the heating surface, the whole boiler is incased, thus excluding air leakage around the boiler. This practice, by the way, is taken directly from marine practice.

The heating surface, that part of the boiler whose duty it is to absorb heat, must have special structual arrangements for that purpose. The first principle to recognize is the limitation of high pressure. Turbines demand high pressures and the heating surface must be able to produce high pressures successfully. High pressures call for a high degree of superheat, right up to the limit of the existing metals. Therefore we find the boiler working in pressures from 150 to 270 lbs. per sq. in. as low pressure boilers and from 350 to 500 lbs. per sq. in. as high pressure, while there are experimental boilers working at pressures considerably over 1000 lbs. per sq. in. as we have seen, with the maximum of superheat. In general it may be said that the working pressure of today is nearer 1000 lbs. per sq. in. than 100 lbs. per sq. in.

This necessarily limits the boiler heating surface arrangement. No scheme of construction requiring large drums is to be considered; fire-tubes are out of the question. Stayed surfaces may not be used. The only boilers worthy of consideration are the

water-tube type with small drums. If headers are to be used, they must be of the divided type. The boiler, so far as the heating surface is concerned, becomes a pressure vessel built to withstand extremely high pressures and capable of contraction and expansion without undue strain on the structure of the vessel.

With drums limited in size and headers equivalent to tubes, so that the boiler is structually strong, the next important item is the avoidance of burns or locally overheated spots. Any spot kept wet, or intermittently wet, is safe. There must be an avoidance of steam pockets or dead areas. The system whereby the surface is kept wet is known as the circulation system and for any system there is a limit of steam generation beyond which the system fails.

The basic principle of such a system is a rising and a falling leg, a closed circuit path. There may be a difference as to detail but all boilers must conform to such an arrangement. In the rising leg there is a mixture of steam and water; in the falling leg there is water only; therefore there is a difference in the hydraulic head of the two legs. This difference gives the pressure which makes circulation possible. Then to promote circulation, there must be localization of heat on the rising leg and as high a head of water as possible between the heating surface and the drum. This means high boilers. There must be no restricting of the steam and water in the rising leg. With high pressures the steam bubbles are smaller and this, of itself, allows of better circulation.

The gas side conditions must be favorable to the absorption of heat as well as the water side. As in all other heat transfer apparatus, mixing, subdivision of the stream, favorable hydraulic mean head, mass flow, radiation, and radiant heat all play their parts. Absorption from the hot gases is better due to the tapering of the gas passes. Transverse passes are better than longitudinal passes for mixing action. Small tubes are better than large tubes, but the tubes must be large enough to support themselves and have the required pressure strength. Baffles aid the mixing and it has been found that as the gases get cooler it is desirable to change the hydraulic mean depth and to add an economizer for water or for air or both and to cut out heating surface.

Superheaters are necessary to the modern boiler. There is no wetness to protect the superheater, therefore there must be some

provision for its safety. There are two films in contact with the metal, however, one inside the tube and the other on the outside, and its temperature is determined by the resistance of these two films. The standard location for the superheater is just beyond the first few rows of tubes to protect it from the radiant heat. This is known as the inter-deck location and has the advantage of giving a constant superheat with variation of load. Superheaters may be located in the radiant heat zone, as witness the superheater in the back wall, but they have the disadvantage of giving a variable degree of superheat, falling off with increase of load. Typical curves for the two types of superheaters are shown in Figure 2.

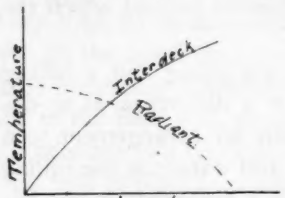

FIG. 2

There is a growing recognition of air control and its importance; of the value of burning out of the fuel completely before the heating surface is reached. This means high boilers, shorter flame, and better mixing. Heat recovery is claiming its share of attention, both by the use of air pre-heaters and economizers. The whole heating surface must be intelligently split up between economizers, contact heating surface, superheaters, and radiant heating surface in accordance with the needs of the particular job to be done.

The tendency in boiler design today is towards:

(1) Larger units of the water-tube type, with the improved economy obtainable with such.

(2) Higher pressures, which keeps the units small and regular in form, limited to individual forged headers carrying tubes, or drums carrying tubes directly.

(3) Superheaters to work always at the highest temperature that the metal will stand, from 700° to 750°, every effort being made to keep the degree of superheat constant by the location of the superheater.

(4) Re-superheat of the steam during expansion.

(5) More radiant heat surface, both as a means of getting more out of the boiler and as a protection of the furnace walls.

(6) Use of air pre-heaters and economizers.

(7) Equipment for the close control of the air.
(8) Higher ratings in B. T. U. per square foot of heating surface, which calls for vigorous circulation and good overall absorption. This means high boilers with small tubes and carefully designed passes.

It is only within the past few years that any real study has been devoted to the boiler, and that has been due to the development of the steam turbine. With the old reciprocating type of engine, almost any sort of steam at any pressure would do, and did do. There was sometimes the limitation that the steam pressure had to be high enough to blow the whistle but that was about all that was required. Today we find the turbine dictating the steam pressure and the temperature.

Turbines may be classified in several ways but, in general, it is customary to look upon them as either impulse or reaction turbines. A pure impulse turbine would be one in which the steam passed through stationary nozzles, and suffered a drop in pressure which was converted into kinetic energy. This high-speed steam jet then impinging on the blades of the rotor, rotation would result. In the pure reaction turbine the steam would pass through a set of stationary blades and be directed into a set of rotating blades. As the steam passed through the rotating blades there would be a drop in pressure from the entrance to the exit sides. This drop in pressure would increase the velocity of the steam, producing a reaction or thrust on the blades, thus producing rotation. There is no such thing as either a pure reaction or a pure impulse turbine. Practically, there is some reaction in an impulse machine and some impulse in a reaction turbine.

The turbine is primarily a high-speed machine. Since the blades are impelled by the steam jet, their speed is bound to be high unless each pressure drop, in the impulse turbine when going through the nozzles and in the reaction machine in passing through the moving blades, is made very small.

As an example, if a turbine were built for a throttle pressure of 205 lbs. per square inch (absolute) and a back pressure of 1″ of mercury, with a Rankine efficiency of seventy-six per cent, the steam being initially dry, the line A-B in Figure 3 is the steam condition curve. Initially it has a total heat of 1,198, while in its final state at exhaust pressure it has a total heat of 917. This

means that there are 1,198 – 917=281 B.T.U. per pound of steam to be turned into work in the turbine.

Without going into the design of a turbine, let it be assumed that this 281 B.T.U. is to be used up in nine steps. That would be, for equal divisions, 31.2 B.T.U. per step. Reference to our steam table shows that the steam velocity due to a 31.2 drop is 1,250 feet per second. For the impulse turbine the ratio of veloc-

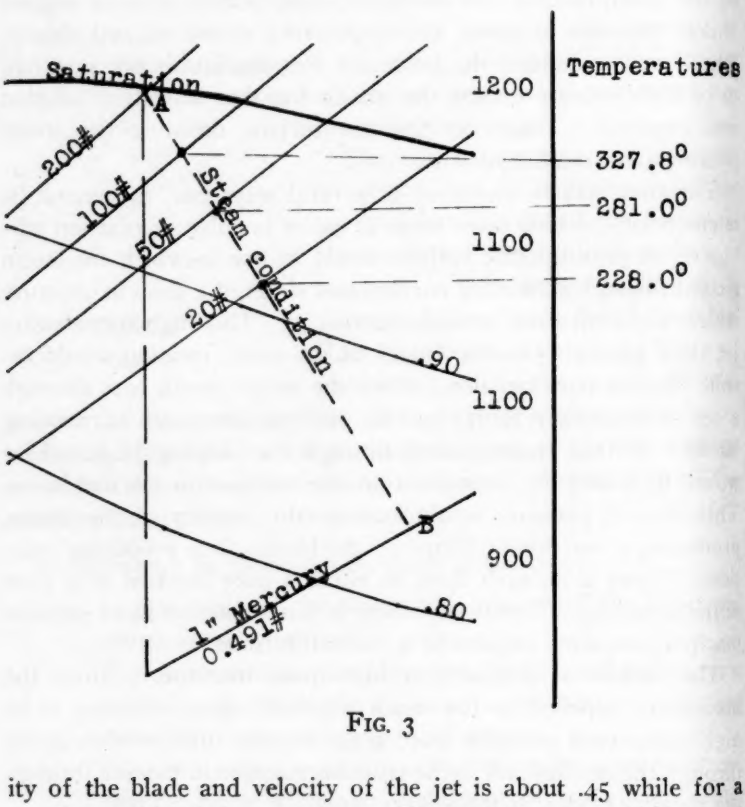

FIG. 3

ity of the blade and velocity of the jet is about .45 while for a reaction turbine it is around .75. This would mean a blade speed of 565 feet per second for the impulse machine and about 940 feet per second for a reaction turbine.

In the actual design of turbines it is considered good practice to keep the blade speeds about 650 for the reaction turbine and a bit higher, around 700 feet per second, for the impulse machine. Therefore our example above would have required fewer steps in

the case of the impulse machine and more steps in the case of the reaction machine.

It is interesting to note what has happened to the volume of the steam as it has gradually slid down the steam-condition curve. If it be assumed that there was one pound of dry steam at the start, then the volume will change as follows:

#/in.² absolute	Quality	Volume occupied, cubic feet	Per cent of original volume
205.	1.000	2.238	100.0
100.	0.962	4.270	191.0
50.	0.936	7.980	357.0
20.	0.905	18.200	814.0
00.491	0.830	540.000	24100.0

The last column, showing the increase in volume in percentages, gives some idea of the problem of the turbine designer and supplies a reason for various schemes employed in the designs of individual machines. There is an immense volume of steam to get rid of at the last stage and a correspondingly small amount coming into the turbine. If the turbine is designed and built so that it handles the steam at the throttle pressure with any degree of success, what will it look like in the final stage?

The solving of this problem has led to the development of the radial-flow type of turbine, where the steam flows in a line at right angles to the shaft instead of parallel to it; to the double-flow turbine where the low-pressure steam is divided, part going to one section of the turbine and the remainder to another, each part being expanded independently; to machines built with ever increasing gauging of the blades, to pass the steam through more easily with a slight loss in efficiency; and to "bleeding," where steam is drawn from the turbine at one or more pressures and used for heating feed water or for other purposes.

Referring again to Figure 3 there are shown three places, with the corresponding condition of the steam, from which bleeding might be effected. In practice these points would probably correspond with some point in the turbine where the blading changed or where the diameter of the drum was increased, thus furnishing a convenient place to take away a part of the steam and reduce the volume to be handled by the turbine in the lower stages.

As was noted from the example, the impulse machine can stand a greater drop per stage than the reaction machine. This

means that a reaction machine will be a longer machine than an impulse machine, for each additional stage takes up more length along the shaft. If the problem were to be worked out in detail it would be found that the steps should be anything but equal for the reaction machine, and only very small drops can take place in each one of the high pressure stages. This means even more stages for the reaction machine.

To get away from this handicap of great length it has been found expedient to combine the impulse and the reaction machine, in the case of the so-called reaction turbine, using an impulse wheel as the first stage and getting a fairly large drop of the high pressure steam, using up around 100 of the available B.T.U. in the impulse wheel alone. The remainder of the machine is built on the reaction principle. Figure 4 shows the relative floor space which would be occupied by: (1) reaction turbine, (2) combined impulse and reaction turbine. Not only is floor space

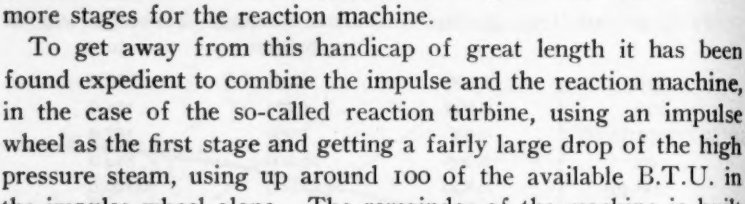

FIG. 4

saved, but also weight, which may be very important. The resulting efficiency is little lower, if at all, than that of a straight reaction machine. This is due to the high leakage in the high-pressure stages of a reaction machine.

Thus we have various types of turbines, such as the Curtis, of the General Electric Company; the Westinghouse, built as a combination machine; the De Laval, Ingersoll-Rand, and the Kerr, all impulse; Terry turbines, generally built single-pressure-stage; the Allis-Chalmers and the Ljungstrom, which is a radial-flow, reaction turbine. There are many more but the above are typical of the whole field. Today they are all about equally good, any company building as good a machine as the purchaser wishes to buy. It is a matter of a little more careful design for the in-

dividual installation and probably more weight to get just a little higher efficiency. The excess cost of the machine would be quite apt to eat-up the increased efficiency obtained. For this reason turbines have become more or less standard and, unless there is a very particular reason for wanting some special feature in a machine, it is good engineering to take one of a standard design.

Therefore our turbine problem becomes one of the selection of a number of turbines, each about equally good. Having made our selection and installed the machine, little can be done to improve its efficiency. To maintain its best efficiency, the turbine must be given constant care and attention, clearances frequently checked, glands kept in shape and leaks plugged, and the best, or designed, vacuum maintained. Plant efficiency will seldom be materially increased in the turbine room.

When the first condenser was built it undoubtedly was designed for just the purpose that the name would imply; to condense steam and get it into water again so that it might be returned to a boiler. That is no longer the case. It is now realized that the one great object of the condenser is to establish the lowest possible pressure on the low-pressure side of a steam turbine. It is fundamentally a part of the turbine and should not be considered as a separate unit. Its relative merit is determined by the vacuum, or low absolute pressure, which it can maintain with a given source or supply of cooling water.

Thermally, the condenser may be divided into two separate parts: (1) the condensing side, where the source of heat is a condensing vapor, and (2) the liquid side, where the receiver of heat is the liquid rising in temperature.

Ashore there are two types of surface condenser recognized; (a) the standard, in which the steam passes around the tubes in contact with the shell, while the cooling water passes through the tubes, either single or multi-pass, the condenser being either vertical or horizontal; and (b) the water works type, in which the water passes around the tubes and the steam through them. The standard type is by far the more common, the latter type finding its field of usefulness in the plants of water works companies, where the whole, or a fraction, of the output of the pumps is used as circulating water. In the marine field, only the standard surface condenser need be considered.

Let us examine the condenser, first from the steam side. It is quite certain that there must be a sufficient area for the admission of the steam from the lowest pressure stage of the turbine to the condenser itself. As we have seen in our computation of volumes, that is in itself no mean requirement. The steam enters the condenser at a very high velocity and is full of eddies, cyclonic in nature, whirling and swirling, a real storm. This mass of steam must be spread out over all of the tubes, and there are many tubes in large tube banks. Therefore there will be friction and a pressure drop across the tube banks tending to defeat the very object of the condenser; that of obtaining the lowest possible pressure. The design must be such as to make this drop as small as possible, so that there will be a minimum of drop between the air pump connection and the entrance for the steam.

There will always be a certain amount of air present in the steam, partly due to air carried in with the feed, and air leakage through glands, joints, and packings. Air forms a film on the tube surface, makes pockets wherever an opportunity presents, and must be cleared from the condenser as rapidly as possible. There must be a uniform sweeping of all of the tubes to push the air along to the air pump suction. It is essential that air pockets be not allowed to form.

In the interests of economy, it is necessary that the condensate shall leave the condenser at as high a temperature as is consistent with the vacuum. There should be no refrigeration of the condensate. The air which leaves the condenser should be cooled as low as possible on its way to the air pump suction, thereby reducing its volume and ability to hold moisture. This is accomplished by the air cooler, which may be a part of the condenser proper, or a separate piece of apparatus outside of the condenser.

The arrangement of the tubes as affecting the flow resistance and consequent loss of vacuum has given rise to several methods of tubing a condenser, such as

(1) entrance lane method, where lanes are left to allow the steam to more easily reach the condensing surface.
(2) entrance lane and exit method, where both entrance and exit lanes are provided, leading to tube layer construction.
(3) the eccentric type, as developed by the Westinghouse Electric & Manufacturing Company, and

(4) the irregular, graduated spacing of tubes arrangement, where the tubes are spaced wide near the entrance and then spacing is reduced as the steam travels towards the condenser hot-well.

On the water side it is desirable that there shall be a minimum of film thickness and this is obtained by giving the highest possible velocity to the water. To obtain a high water velocity may involve great pump work; therefore it may be necessary to compromise between thermal efficiency and pump work. The tube areas must be correct for the volume and velocity of the water to be passed through the condenser and this has led to the multi-pass type of condenser, which gives the maximum of area for the amount of water flowing. Both ashore and afloat the modern tendency is towards the single-pass condenser with a large circulating pump.

The head to be overcome is determined by the whole resistance. As a general rule there is no static head, the work being all flow work, which includes the friction of the tubes, eddy current losses at the entrance and exit, pipe friction entering the water box, discharge, and overboard plus eddy currents in the water boxes.

It is essential that there shall be an equal distribution of water between all of the tubes, which means that it is necessary to equalize the static heads to give equal flow through the tubes.

In the case of the marine condenser, conditions are quite a bit different from those which obtain ashore. While it may not be absolutely necessary that the turbine be located in line with the shafting, i. e., at the same level, yet it is very convenient both from the viewpoint of the structure and the safety of the ship. It is conceivable that a ship could be so constructed that the condenser might be placed directly below the turbine; made a part of it; but that would be freakish design indeed. Marine condensers have to be made separate from the turbines, set on their own foundations, and considered apart from the turbine.

This means that special care must be taken in the exhaust connection from the turbine to the condenser. It must be large enough to carry all of the steam without any appreciable drop. It must be tight, for in this connection we will have almost atmospheric pressure trying to force air into the system. Its lines

must be such that the steam will flow naturally, without crowding to one side or the other, creating dead spaces and thus choking the entrance to the condenser. There must be freedom of movement for both the turbine and the condenser, due not only to temperature and weight changes but also to the motion of the ship. It must be so designed that it will operate well when water is being supplied by circulator or by scoop, with a minimum of friction and a maximum of effectiveness in each case. It must resist corrosion. It must function well with either the icy water off Newfoundland or the heated waters of the Red Sea. The marine condenser is up against a much stiffer proposition in every way than the condenser ashore, and requires the utmost of consideration. The one thing in its favor is the fact that it does not have to be built in such large sizes, generally, as those on shore.

When the condensate leaves the condenser hot-well, it is fairly cool; the better the vacuum, the cooler the condensate. Before this water may be fed to the boiler again it is found wise to heat it to something approaching boiler temperature: therefore the feed-water heater.

There are two general classes of heater in use, the open and the closed type. Both types employ condensing steam as the source of heat with the difference that in the open heater the condensing steam and the heating water are in intimate contact while in the closed heater there is a metal wall separating them. Thus the open heater has the advantage of the elimination of heat transfer surface, tends to liberate the air in solution with the water and acts as a purifier, for the solubility may be lessened by the higher temperatures and scale forming particles deposited in the heater instead of in the boiler. On the other hand, it breaks the water-line. The pressure in the pipe line goes to that of the steam in the chamber. Since the steam in a plant is always subject to variation, the open heater does not fit readily into most systems. It is also subject to the disadvantage that whatever of foulness there is in the steam is necessarily communicated to the water.

Closed heaters, on the other hand, will keep the condensate pure but will not eliminate either scale forming particles or air. They may be operated at a definite pressure and the water forced through them instead of taken away from them.

Both types are in use ashore but there seems little question of the desirability of the closed heater for service afloat.

To obtain the maximum of efficiency from the heater it should be so designed that the liquid stream flowing over the heating surface is very thin, so that a greater portion of its surface will come into contact with the heating surface; the stream must be well mixed by baffling, multi-passes, or staggering of the tubes, but care must be taken not to impose too much flow resistance, thus building up pump work to too great an extent; dead pockets must be eliminated; it must be easily cleaned, there must be an elimination of unnecessary joints; provision made for expansion;

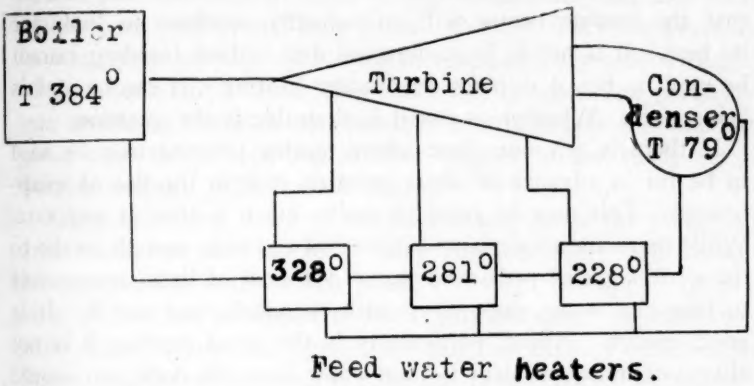

FIG. 5

it must be strong enough to stand high pressures, which limits its size and shape; and it must be protected from corrosion.

If the feed water is to be brought up to anything approaching boiler temperature, a considerable amount of steam will be required for heating purposes. The higher the temperature to which it is desired to heat the feed, the higher must be the pressure of the heating steam, for the temperature is a function of the pressure. This has led to the practice of putting two or more heaters in series and heating by steam bled from the turbine.

A simple diagram of such a system is shown in Figure 5, with steam bled from the turbine at the three pressures given in Figure 3. Were it desired to bring the feed water up to more nearly boiler temperature, a fourth heater could be installed and heated by live steam.

It must be realized that the conditions as pictured above only obtain for the load at which the steam-condition curve was drawn. As the load changes, so will the pressures and temperatures. For this reason it is evident that this complicated system of bleeding is at its best when the load conditions are constant and right for the best pressures and temperatures. One can hardly imagine it in use on board ship under maneuvering conditions. With its complications of piping, multiplicity of heaters with their consequent weight, and variability under changing load, it does not look like the right thing for the naval service.

The other means of obtaining heating steam are from the auxiliary exhaust and from live steam. It is to these two sources that the marine heater will undoubtedly continue to look for its heat. It is not to be understood that turbine bleeding cannot be used on board ship for feed water heating. It can be and is being used. Whether or not it is desirable is the question.

If there is any one place where marine practice may be said to be far in advance of shore practice, it is in the use of evaporators. This may be from necessity, but it is true at any rate. While there are some plants ashore that are wide enough awake to the advantages of pure feed water, yet most of them are content to take city water, dope it up with chemicals, and use it. It is good enough. Afloat, particularly in the naval service, it is not always found convenient to take water from the dock, nor would the water be considered suitable even though available. The use of evaporators ashore is not common enough to make a comparison interesting.

Lumping the auxiliaries and taking them as a whole, we find the land and ship practice quite similar. The centrifugal pump is accepted as right for the circulator, the reciprocating type of pump being only justified in operation with reciprocating main engines where high vacuum is not essential. The best practice dictates a centrifugal pump for the condensate and a rotative dry vacuum pump for air removal. Boiler feed pumps may be either of the displacement or centrifugal type.

How does the practice of engineering at sea compare with that ashore? What may be done to improve it? Before one may delve very far into that it is necessary to differentiate between marine practice in the merchant service and in the naval service.

The merchant ship slides into port, goes alongside and pays off. Maybe the chief engineer, a couple of the assistants, and two or three of the men will be told to stand-by her; just enough to run the auxiliary watch. Shore gangs come on board and do whatever work has been ordered, and the chief has been careful not to turn in too long a repair list. The day before sailing the crew signs-on for the voyage. Meanwhile perhaps one of the assistants has quit the ship. If times are hard there will be plenty of good men to be had. If there is plenty of shipping it will not be so easy to pick a good crew. At any rate, men are signed-on and they are the ones who will take her to sea.

The next morning a couple of tugs come alongside, toot their whistles, and yell up to "bear a hand, there." They are probably in a hurry to get tied up for the afternoon! They snap a couple of lines on board and our ship heads out to sea. The port captain stands on the dock and breathes a little prayer that she has gone, then starts hounding another skipper to get ready for a Sunday sailing. What of the ship?

She pokes along down to the pilot vessel, drops the pilot, and then heads out into the sea. They ring her over "full ahead" a couple of times, the watch is set, and then that ship is on her own. There are no duplicate lines tying her plant in with some other plant which can "grab the load" in case of emergency. There must be no emergency. She has been reported as "sailed" and it is up to her to get in the "arrivals" column as quickly as possible.

Shore plants are subjected to severe storms occasionally, perhaps two or three times a year. The ship may plough right out into a head sea and a howling gale. She is liable to be pitched and tossed, battered and slammed from the moment she clears the light until she drops anchor in a friendly harbor, wheel out of the water half of the time and the main suction out the other half.

About the second day out the chief may find out why his assistant had important business ashore and was not able to make the trip. It is then too late to do anything but plug along and make the best of it. Some of the crew shape up as sure-enough sailors; others prove to be tourists. At any rate all hands turn-to (the mate and the first see to that) and the crossing is made.

What a thrill there is in reaching a foreign port! The health authorities clear the ship, the old man breaks out the roll and

Jack draws half his wages. Then, stepping high, wide, and handsome, he heads up the main thoroughfare and ruins himself for work for the next couple of days. Meanwhile the ship has discharged her cargo, taken on board whatever is available, and is ready to put to sea again. Need we make the return passage? That is the problem of the average cargo ship engaged in the foreign trade. The passenger liner is more fortunate but the idea is the same.

Shall we design a plant for those ships to catch the last little B. T. U. available or shall we put a plant in her that will take her over and bring her back, regardless? Good engineering is as much a matter of "comeage and goage" as it is of saving every possible B. T. U. It must not be supposed that the steamship operators who are prone to favor the Scotch boiler are entirely in the wrong. They have probably been to sea. There may be something in that Scotch-boiler theory for ships in the tramp cargo trade.

With the Navy it is a different story. There the men are more or less permanent; the officers quite so. The ship is their home and there is every incentive for them to keep her right. The men are encouraged to study and many of them develop into excellent mechanics and engineers. In such a ship there is good justification for putting in equipment which is not fool-proof; machines which require a good bit of attention; apparatus which needs careful supervision; a real economic plant.

But the first duty of the Navy is not to save money. The Navy is built as an investment against a disastrous war, not as a money-saving device. Economy must be sacrificed if it would seriously interfere with the function of the ship. In looking at the plant, that one factor must bear more weight than any of the others.

He would be a bold man indeed, who would more than point to the places where we may expect development in the ship's plant. Higher pressures may become the vogue; the boiler heating surface may be rearranged with more radiant, economizer, and more superheating surface; a nicer heat balance may be attempted; pulverized coal, with its attendant military advantages, may take the place of fuel oil; bigger units may be installed; but water will still flow out of the scuppers just the same.

THE "SHAW"-"AQUITANIA" COLLISION

By A. G. Berry, Jr.

THIS is a story of my experiences on the U. S. S. *Shaw* in her collision with H. M. S. *Aquitania* while escorting her to Southampton, England, in company with three other destroyers. The accident occurred in the pre-dawn hours of October 9, 1918 and, while more or less ancient history now, may prove of interest to some as a narrative of what I consider a narrow escape. The story of the after portion of the *Shaw* was ably told by Peter Clark MacFarlane in the *Saturday Evening Post* and in it he paid glowing tribute to those heroes—as such they are—on "the other end" during this trying time. All I succeeded in doing was to save my neck, but here's the story of it anyway for those who may be interested.

It had been a rough, tempestuous trip; we had lost a man overboard the day before, due to heavy seas, and during the night preceding, the destroyers had rolled and pitched in the darkness as they zig-zagged with the escorted vessel at a high rate of speed.

It was about a quarter to six in the morning; just getting light, the sky was overcast and the seas running fairly high. The *Shaw* was in a position about 700 yards on the port bow of the *Aquitania* making about 27 knots while the latter was pounding through the sea at twenty-three. She had on board about 10,000 American troops and the Channel had been reported as harboring enemy submarines in our vicinity.

My room was the center one of three on the port side of the fore and aft passageway in the forward part of the ship, and at this time I was asleep in my bunk, as were all others who were not on watch. Suddenly out of my slumber, I heard the sound of a whistle, siren, and general alarm. As all of us slept fully clothed, except for our shoes, I was prepared for the occasion. I hopped from my bunk, turning on the light as I did so, slipped into my sea boots, grabbed a life preserver (as much for protection against the cold as the sea), and turned inboard toward

the door. I had my hand on the door knob when I heard the most terrific explosion; the light went out and I was catapulted across the room, striking my head against the outboard bulkhead, falling amidst shattered glass and water.

Naturally, the blow on my head, coupled with the fact of just having awakened from a sound sleep, left me dazed, and I tried to adjust myself. I had no idea what happened but the explosion sounded as if we had been torpedoed or had struck a mine; but my mind being still slow acting, I had the odd feeling of being in a dream, until my feet began to get wet. My room was slowly filling with water!

You can just bet that this snapped me into action quickly! I had my life preserver clutched in my hand all this time, and in the darkness I put it on instinctively and then splashed my way towards what I thought was the door, only to find a solid wall of steel. A hasty feel of the other four walls brought the same results. You can imagine my feelings at that time.

I was trapped in a room about ten feet square, in total darkness, with water slowly rising around my legs—and I wasn't getting out! There had been a door to my room when I had turned in, but search as I might, it simply wasn't there now. I began to get slightly agitated,—to put it mildly. I didn't want to admit I was scared, but I WAS! and I feverishly searched in the darkness for something—anything—to help me through those quarter-inch walls of steel to open air where I had a fighting chance.

I thought of a flashlight which I always kept handy, but I couldn't locate or recognize anything in the room. All was in confusion, water, and darkness, and I realized my time was getting short, as the water was rising; rising slowly, but surely to what seemed to me certain death by slow torture.

I couldn't just sit still and wait, so I mechanically splashed around, always feeling and hoping. Suddenly my hand recognized the familiar feel of the flashlight. Sudden joy rushed through me, only to be followed by a deep foreboding. Would it work? I felt around it for the button and suddenly a beam of light shot out. I didn't waste any time because by this time the water was well up on my legs and I feared the ship would sink before I could get out.

Rapidly the beam of light flashed from wall to wall. I had been right; there was no door! My hopes dropped completely out

of sight when suddenly the light accidentally played overhead, and there, directly above me, was the door. The ship was on her side, and I had been standing on the outboard bulkhead, and in the darkness, water, and general confusion, I had not known it!

Breathing a prayer of thankfulness, I jumped up, turned the knob, and the door, opening inwards, fell towards me and by dint of chinning myself, I managed to get into the passageway above. In passing, let me state, that the door to my room had always stuck when closed, and I always used to hook it open in order to have no trouble in getting out suddenly if necessary. On this occasion it had been jerked closed by the force of the blow, and in doing so, it had become unjammed and worked easily, as any door should. Thus, the works of Providence!

Although better off than before, I still wasn't out of the woods, or sea in this case. I crawled along the passageway on my hands and knees and came to open air. There were about fifteen men sitting on the jagged edge, where the explosion, or blow, had occurred, dangling their feet in the water, all wondering what it was all about as they too, had been plunged from sound slumber into chaos. All were most surprised to see me, as it had been about fifteen minutes, as I was told later, since the explosion. You can imagine how long those minutes were to me.

None of us knew where the rest of the ship was, nor what had happened. It was just beginning to get light and about a half a mile away was a destroyer, which one I could not tell as her bow was enveloped in flames and smoke, and the air was rent by the sound of an occasional explosion from a four-inch shell. We thought the convoy must have been attacked, and that this ship was firing at some submarine which we could not see, and that our ship had been torpedoed or mined—no one knew which.

About this time one of my friends asked me if I had a camera, which irritated me considerably, as I was far from the mood for taking pictures. Then I heard someone ask who had had the officer-of-the-deck watch the previous night, and how the depth charges had been set. I replied that they had been set to go off at 150 feet.

Believing our stern to be somewhere beneath us—none of us was doing any very clear thinking—some optimistic soul remarked that the stern "should be just about 150 feet down by now." This was a happy thought, if true. It meant that at any

moment fifty 300-pound depth charges filled with TNT would go off directly beneath us and blow us sky-high. To make matters worse, at this moment the bow, which had been on its side, suddenly up ended, incidentally closing the passage way through which I had emerged but a few moments before. This was enough. No one hesitated at all. You have seen frogs leap off a rock in a pond when scared? That is a faithful picture of us as we dove into the water from our perch on the bow.

There were many mattresses, boxes, pillows, and the like; four others and myself annexed a mattress and clung to it. The sea was rough and covered with fuel oil from our punctured oil tanks. We took a rapid survey of our position. A couple of destroyers were in sight a few thousand yards away and we tried to get their attention, but to no avail, and although our abandoned bow was still afloat, we were afraid to go back to it. What to do?

We tried propelling our mattress-raft towards the nearest destroyer. Each time we got near her, after much hard work, as it was directly into the wind and sea, the destroyer got under way and moved a little farther off, in spite of our efforts to attract her attention. We repeated this performance a couple of times and it almost seemed as if she were deliberately avoiding us. This is accounted for by the fact that we were so low in the water that we could not see what was going on. This was most downheartening, and finally for lack of anything else to do, we came about and tried to paddle to one of the other destroyers, farther off, it is true, but apparently stationary. After much buffeting by the seas and after having swallowed what seemed to be gallons and gallons of oil and salt water (a delicious mixture!), we saw approaching us a whaleboat from the first destroyer we had tried to reach and we were dragged aboard, cold and weak, but happy.

We were taken to one of the near destroyers, the *Kimberly*, and it was only after getting safely on board that we could find out what had happened. While zigzagging towards the convoyed ship at a converging angle of about sixty degrees, the *Shaw's* rudder jammed and the huge vessel passed clean through her cutting off sixty feet of the bow, and passing through the room next to mine. The officer in that room and one in the room opposite were killed as were fourteen men in the compartment almost directly under me. That was too close for comfort!

RADIO FOR AIRCRAFT

By Lieutenant H. F. Breckel, U. S. Naval Reserve

IN EFFECTING a comparison between the present-day methods of radio communication and those of a few years ago, one who has followed the progress of the art cannot but be impressed with the truly remarkable developments that have taken place. It is not difficult to recall the days when such devices as the radio telephone, (vacuum tube type), the radio beacon, etc., were unknown. Prior to 1916 no aircraft were equipped with radio apparatus and communication between planes and lighter-than-air craft and ground stations had not been put to practical use.

The original practical experiments, conducted with the view to equipping naval aircraft in the United States with radio apparatus, began during the summer of 1916 when available apparatus for this work was rather cumbersome if not crude and many handicaps had to be overcome before success was assured. The question of weight being of paramount importance, much consideration was given to this phase of designing an efficient, practical equipment of compact proportions which would stand up successfully under flying conditions. The earlier types of radio transmitters for aircraft were of the so-called "spark type" which, after much refinement, were generally adopted. Some of these transmitters made possible communication over distances somewhat in excess of 100 miles under favorable conditions, although at times these sets proved very erratic in performance. During the late war, many French aircraft cooperating with the convoy escorts were equipped with radio transmitters which, generally speaking, performed very well under flying conditions over distances of seventy-five miles or more. These sets transmitted a queer wavering "note" that could be immediately identified as originating from an aircraft station, a highly undesirable characteristic from the military or naval viewpoint of radio secrecy in wartime. The writer had occasion to inspect one of these units at the radio repair base of the French Navy at Le Havre. The

design was quite efficient, the set being very compact, rugged, and at the same time very light in weight. Current for operating the transmitter was furnished by a small wind-driven generator mounted on one of the struts, a conventional method for supplying power in general use today that is quite practical.

During the experimental work by the Navy much valuable data was obtained during the trials and measurements of various types of antennæ with a view to determining which of the various forms available would be most practical for aircraft purposes. After many tests, the so-called trailing wire type was adopted and is still standard and in general all-round efficiency can be considered the equal of the average ground station antenna. For a ground connection the conventional "counterpoise" type is, of necessity, generally employed, being merely a system of wires usually built-in in the upper and lower wings of the plane to which is electrically connected all other metal parts of the craft such as guy wires, motor, etc. The antenna wire is usually contained on a reel and leads out through the side or bottom of the fuselage, the end being weighted to keep the wire as nearly vertical as possible when the plane is in flight. This wire is reeled in before landing.

In the earlier experiments with receiving apparatus for planes many standard types of equipment then in vogue were tried out under practical conditions which permitted reception of signals over rather limited distances. Much difficulty was encountered in connection with this problem because of the terrific aural disturbances ever present aboard aircraft. This made it hard to receive signals with sufficient strength for the operator to hear them. It was also found necessary to give special attention to the head telephones in order to exclude the noise set up by the motor, propeller, and rushing wind. Present-day "receiving helmets," as they are called, are of such design that they readily exclude the greatest portion of extraneous aural disturbances, thus permitting the operator to receive signals of comparatively weak intensity. The standard head telephones now mounted directly in the operator's helmet are covered with several layers of soft felt which not only excludes noises but also makes it possible for the operator to wear the headset for long periods without tiring his ears.

With the advanced development of the vacuum tube, the invention of Dr. Lee DeForest, and its adoption for use in both trans-

mitting and receiving apparatus of all descriptions, the design of aircraft underwent a revolutionary change. Great success was had in developing efficient and practical transmitters and receivers of the vacuum tube type for flying craft. The tube transmitters of this type permit easy communication with aircraft over distances of hundreds of miles. In this connection it might be well to cite for example the excellent performance of the U. S. S. *Shenandoah,* whose efficient radio apparatus proved so valuable during the trans-continental flight of 1924, when it was deemed necessary to utilize every possible channel of radio communication. Quoting from the Bureau of Engineering *Bulletin* of November, 1925, the following extracts from the radio officer's account during the flight are very interesting and serve to emphasize the practicability and efficiency of the apparatus.

Advance arrangements were made with Army, amateur, and broadcasting stations and the *Shenandoah* was able to maintain continuous communication when out of range of the naval stations. Communication was maintained every night with the naval radio research laboratory at Bellevue, D. C., on prearranged schedules and signals were exchanged with 250 amateur stations working on waves below 100 meters, located in thirty-nine different states. An average of 7,500 words per day was transmitted, half of which constituted press items written by a newspaper correspondent on board. While moored at San Diego, the 90-meter signals of the *Shenandoah* were heard by the U.S.S. *Canopus* in mid-Pacific, the range being about 4,200 miles. These signals were also reported heard by Mr. F. D. Bell, of Palmerston, New Zealand, the distance covered being approximately 6,180 miles. While near the San Francisco radio station, that station suggested that the *Shenandoah* take over the control by radio and work Annapolis. This was accomplished successfully, the San Francisco operator probably having connected a relay arrangement between their receiver and transmitter thus permitting the *Shenandoah's* signals to actuate the powerful San Franscisco shore station. In connection with the navigation of the giant ship, a number of radio compass bearings, from twenty-five to fifty per station, were obtained from practically every station on the west coast and proved to be very accurate even in the uncalibrated sectors. The radio compass equipment proved exceedingly valuable in effecting the mooring at Camp Lewis, on the west coast when heavy fogs were encountered which totally obscured landmarks and made it impossible for the *Shenandoah* to sight the mooring mast until she arrived within a mile of same, notwithstanding the fact that searchlights were played upon the mast, smoke bombs fired and everything possible had been carried out to assist the ship. In this case the ship was ably "conned" by the use of radio and the lookout perched atop the mast who was in telephone communication with the ground radio station below, which, in turn, advised the ship as to bearings etc., via radio.

The greatly increased ranges of the foregoing transmissions amply demonstrate the highly augmented efficiency of the modern vacuum tube type transmitter as compared to the late war models previously described.

The modern aircraft receiving units are also masterpieces of design, their general features comprising combinations of the so-called multi-stage radio-audio frequency type. The most sensitive, as well the most practical is the popular super-heterodyne unit, which is in general use today. One of the late army aircraft receivers of the above type is a very compact and rather unique design. It comprises two separate cabinets, the larger, only 12″ square by 6″ deep, housing the complete radio and audio amplifiers including the necessary batteries, is mounted in the rear of the cockpit, while the smaller, only 6″ square, containing all the necessary controls for changing the wave lengths and for switching on the tubes and varying their electronic emission and output, is directly in front of the operator. Special vacuum tubes of the so-called "peanut" variety are used making possible economical filament current consumption, thus giving the set longer operating life with a given available battery current supply than it would have were the larger type tubes employed. The general mechanical features of this receiver are very rugged and the electrical efficiency is very high making it very sensitive and responsive to signals over great ranges. In fact, the set is so sensitive that it is possible, without the use of either antenna or loop, to listen to powerful broadcasting stations from 300 to 500 miles distant.

In connection with the sensitive receivers on aircraft, a great deal of difficulty was encountered in overcoming the terrific interference set up by stray currents induced in the receiver circuits by the ignition system of the motor, wherein each spark plug functioned as a miniature spark radio transmitter. The necessity for overcoming this undesirable interference was highly essential. Solving this problem by radio engineers constitutes a very distinct step forward in furthering the all-round reliability and efficiency of radio apparatus on aircraft. As in the case of most other difficult problems the practical remedy proved a comparatively simple one. An elaborate system of "shielding" was used, wherein the entire ignition system circuits were carefully covered by closely woven copper mesh which completely enveloped each lead to the different electrical parts, experiments having proved that

it was necessary to observe this precaution, or shielding of the other parts would be ineffective. This system of shielding is electrically grounded to the metal parts of the plane and has the property of absorbing the stray currents or fields set up by the ignition system, thus effectively preventing their reacting on the receiver circuits.

What can, however, be considered the outstanding, modern application of radio to aircraft is the directional radio transmission or reception, as an aid to navigation. Directive reception is accomplished through the use of the radio compass. Some of the earlier experiments conducted by the Navy developed a practical standard equipment for use on board the larger types of seaplanes to enable pilots to obtain bearings on shore radio stations while in flight. A very valuable and interesting example of the use of the radio compass took place during the trans-Atlantic flight of the famous *NC*-4. This plane was equipped with a radio compass for taking bearings during the flight. In the "take-off" at the Azores Islands, in a very choppy sea, the master magnetic compass was jolted out of the gimbals. This resulted in the plane getting headed on the wrong course, actually heading for the coast of Africa instead of for Lisbon. The radio compass was brought into use and with the aid of bearings taken on radio signals of one of the destroyers stationed along the route of the flight the *NC-4* was brought back on the correct course. Another interesting test took place during the summer of 1920 when the twin motored flying boat, *F-5-L* effected contact with the battleship *Ohio,* whose position was entirely unknown by the pilot. Radio signals were transmitted by the *Ohio* during the entire flight and the pilot of the plane shaped his course solely by means of radio compass bearings taken on these signals. The *Ohio* was finally located by the *F-5-L* approximately 100 miles at sea and, after flying above the ship, the plane circled about and made its way back to Norfolk, Virginia, solely by means of radio compass bearings taken on the naval radio station there. Another practical demonstration of the value of the radio compass as an aid to aerial navigation was conducted by the Navy in February, 1919, at the request of the Postoffice Department. An air mail plane was fitted up with the so-called "fixing wing" coils and was successfully navigated from Washington to Philadelphia and return by means of radio bearings. Directional radio transmission, or

to quote the more modern term, the radio beacon, has been more recently developed for the purpose of guiding aircraft on flights over unfamiliar territory, through fogs, or at extreme altitudes, without resorting to observation of landmarks or other means of navigational aid. This is a joint development of the Bureau of Standards and the signal corps of the Army. It is a departure from the conventional radio compass method previously described in that the necessary directional signals are actually transmitted by the ground radio station and received by an ordinary non-directional radio receiver on the plane. This makes it unnecessary to install radio compass equipment on the plane thereby effecting a conservation of space and weight. The development of this application of radio for aircraft undoubtedly constitutes one of the outstanding contributions to the progress of the art.

Briefly stated and without entering into great technical details, the radio beacon comprises two large fixed coil aerials, quite similar in appearance to the conventional radio compass coil, mounted on a common pivotal point. These two coils, for purposes of illustration, can be likened to a book which is stood upright upon one end and opened in the middle, the pages on the one hand representing one coil and those on the other representing the other coil. It can thus be seen that the coils are mounted at an angle with respect to each other in the form of a "V," each coil being energized alternately by a transmitting equipment of conventional design, this alternate energization being controlled by means of a rotating coupler. Through this medium the alternate beacon signals are automatically transmitted, one coil transmitting the code letter "A" and the other the code letter "N." Thus the pilot of a plane which is equipped with a standard radio receiver is enabled to maintain a correct, fixed course while in flight to a point marked by the beacon by simply listening to the two code letters and guiding the craft so that the sounds are heard with equal intensity, or, so that the proper combination of code letters is audible. No matter what the weather may be and in spite of fog or drift due to cross winds, the pilot can shape an accurate course to the beacon for he knows that if the strength of the transmitted bearing code letters vary with respect to each other, he is off his course to the right or left and he has but to change his direction of flight correspondingly to rectify the

error. This system has been tested repeatedly by planes in flight over long distances as for example, between Washington, D. C., and Dayton, Ohio, the greatest error in course on completion of the flight which was unaided by other navigational means, being less than four degrees. There is no question as to the advantages to be derived through using this system as an aid to aerial navigation. While the magnetic compass tells the pilot which way the plane is actually headed, this instrument does not take into consideration drift caused by wind, or air currents and therefore does not give the pilot true information as to the direction of flight with respect to the point he is trying to reach. Where the radio beacon is brought into use the pilot is assured at all times as to his true direction of flight.

In conclusion, it can be stated that the advantages to be derived through the use of radio for aircraft are many, even at this writing, and will doubtless multiply in synchronism with modern progress and development of the art.

NOTES ON THE MEASUREMENT OF FUEL OIL

By Lieutenant S. H. Gambrill, U. S. Navy

About a year ago the author was unexpectedly placed in charge of the cargo oil of a Navy fuel ship. Never having had any engineering experience, the author approached the subject of the measurement of fuel oil with an unbiased if not a blank mind. It soon became apparent that although there were ample instructions covering the physical changes of oil due to temperature there was no literature on the subject of the practical measurement of the oil—or if there were, its existence was unknown to most of the service and to the large commercial companies.

One method of measuring the amount of oil delivered to a vessel is by means of an oil meter placed in the discharge line. However oil meters are not at present supplied to navy fuel ships and are not used by commercial companies to the author's knowledge. The general opinion among destroyer engineer officers seems to be that meters are unreliable. This is based on the fact that it is difficult to tell when the meter is out of order and (possibly) because the meter is influenced by the temperature of the oil and consequently its reading should be corrected for the *mean* temperature of the oil during the fueling. This mean temperature would be very difficult to determine as it would not be the average of the temperatures before and after the pumps were used.

The usual method, which is used by both the Navy and commercial companies, is to compute the amount of oil in the tanks before and after fueling. The difference is, of course, the amount of oil discharged or received. The quantity of oil each time is obtained by taking soundings or ullages of the tanks and entering tables made out for each tank which show the amount of oil in the tank for any given sounding or ullage. A temperature correction must then be applied to the figures to reduce the oil to the volume that it would occupy at sixty degrees Fahrenheit. The Navy uses the formula given in chapter 38 of the *Engineering Instructions* while commercial companies generally use the

tables in the *Bureau of Standards Circular No. 154*. These two formulæ give fairly similar results for small quantities of oil but different results for large quantities.

The method may be put in mathematical form using the formula for temperature correction as given in the *Engineering Instructions:*

Let: A = Gals. of oil at temperature t as shown by soundings or by ullages.
A' = Gals. of oil sixty degrees.
A'' = Gals. of oil received or discharged.
t = Temperature of oil at time that soundings were taken.

Then:
$$A' = A - .0004A(t-60) \quad (1)$$
$$= 1.024A - .0004At \quad (2)$$
$$A'' = A'_1 - A'_2 \quad (3)$$
$$= 1.024(A_1 - A_2) - .0004(A_1t_1 - A_2t_2) \quad (4)$$

Formulæ 1 and 3 are the most convenient to use in actual practice as the subtractions involved are made more rapidly than the multiplications involved in the other formula.

It seems needless to state that the temperature of the oil must be taken at the same time that the soundings or ullages are taken. However the author had one prominent commercial company propose using the temperature of the oil at the time that the pumps were stopped instead of the temperatures at the time that the ullages were taken. The oil had been heated by steam to facilitate pumping, and as the ullages were taken about four hours after the steam was turned off the temperature had fallen about twenty degrees since the time the valves were closed and the pump stopped. The temperature correction was to be applied to a little over 2,000,000 gallons of oil and the twenty-degree error in temperature would have resulted in a large loss, a loss which incidentally would *not* have been in the company's favor.

Furthermore, it seems needless to state that the temperature applies to the volume of oil in the tanks from which it is obtained, and not to the volume of oil given to or received from the vessel alongside. For example, if there are about 2,000,000 gallons of oil on the tanker and the destroyer alongside receives only 60,000 gallons, the temperatures of the oil as taken from the tanker's tanks are applied to the 2,000,000 gallons and not to the 60,000 gallons. This is obvious from formula 1 and 2. The author has, however, had innumerable destroyer engineers tell him that they

did not see the necessity of taking the temperatures on the tanker both before and after oiling as the temperatures could not change over a couple of degrees and this would make no difference when applied to the small amount of oil that they were taking.

A short cut in applying the temperature correction, which is often suggested, is to apply a correction, based on the mean of the temperatures before and after fueling, to the volume of oil pumped as shown by the change in sounding or ullages. This method is not exact as may be seen when it is put as a formula:

$$A'' = (A - A) - .0004\left(\frac{t - t}{2} - 60\right)(A - A)$$

This formula cannot be made to correspond to formula 3 or 4 by any method of simplification or transposition; and the amount of error which will result in its use is dependent upon the magnitude of the temperatures and volumes of oil involved. A large commercial company once suggested using this incorrect method on a 2,000,000-gallon cargo, apparently, because they did not know how to handle the temperature correction when the temperatures before and after fueling were not the same.

If formulæ 1 and 3 are correct and if the tables for converting soundings or ullages are correct, the accurate measurement of oil depends entirely upon the accuracy with which the soundings or ullages and the temperatures are taken. No mathematics can be more accurate than the data on which they are based. The Bureau of Standards no doubt had this in mind when they stated that the *assumed* weight of a gallon of water is 8.32828 pounds.

In measuring oil, a sounding is the distance that the surface of the oil is above the bottom of the tank, and an ullage is the distance that the surface is below the top of the tank. Destroyers generally take soundings of their tanks, and fuel ships and commercial companies generally take ullages. The author has had no experience in taking soundings and will consequently confine himself to the methods of taking accurate ullages. Some of the precautions necessary in taking ullages apply equally as well to soundings.

Before taking ullages or soundings, it is important to make sure that there is the same amount of oil in the pipe lines before fueling as will be there after fueling. Shore stations generally keep all their lines full of oil as the only way for them

to clear the lines is to pump it back up into the tanks. Commercial tankers and navy fuel ships generally find it more convenient to keep the suction lines to their pumps full and the discharge lines empty. This can be assured by opening the pump gate valves, the suction valves of *one* tank and the discharge valves to one or more tanks. As the discharge lines are above the level of the oil in the tanks, this lets the oil run out of the discharge lines through the pump (which is the rotary type) and back to the tank via the suction line. If the suction lines are empty the oil will flow by gravity from the tank into the lines when the valves enumerated above are opened as the suction lines are all below the oil level in the tanks. To overlook these precautions may mean an error of several thousand gallons of oil.

It is essential that the suction lines be opened to only one tank. If two or more tanks are opened to the suction lines and if there is a difference in oil level in these tanks, the oil will be flowing by gravity from one to another while the soundings are being taken. Of course any soundings or ullages taken under these conditions will be incorrect.

Vessels receiving or discharging cargo are subject to changes in list and trim. Consequently the question comes up as to what effect these changes will have on the accuracy of the soundings or ullages. If the opposite sides of the tank are parallel, if the place where the soundings are taken is midway between the forward and after bulkheads, and if the top of the tank remains above and the bottom below the surface of the oil, the soundings will not be affected by a change of trim. Under the same restrictions, changes of list will not affect the soundings if the place from which they are taken is midway between the inboard and outboard bulkheads. Also ullages will not be affected under these conditions provided that the changes of list and trim do not exceed four or five degrees. Commercial tankers generally have the openings in the center of the tanks. Navy fuel ships have them correctly placed fore and aft, but very close to the inboard bulkhead. This gives correct ullages regardless of changes of trim, but leaves a possibility of error in the case of a change of list. However, the navy fuel ships have tanks arranged in pairs, port and starboard, the capacities of a pair of tanks are very nearly equal, and their sides are approximately parallel to each other. Consequently the total amount of oil in

the two tanks, as shown by the soundings or ullages, will not be affected by a change of list provided that both tanks have such a quantity of oil in them that the oil does not expose their bottoms or touch their tops. For example, if the ship takes a half a degree list to starboard, the ullage in the starboard tank may be a quarter of an inch too large; but the ullage in the port tank will be a quarter of an inch too small, and the two errors will cancel.

In taking ullages, a steel tape is used with a bob on its end. It is most convenient to use a brass bob one foot long, and graduated in quarters of an inch from the top down (i. e. the zero mark on the bob is next to the zero mark on the tape). The tape is held against the ullage mark at the top of the tank, and the bob lowered until it reaches the oil, and then it is further lowered until the next foot mark on the tape is against the ullage mark. The bob is then withdrawn and the distance of its oil mark from its top is added to the number of feet that the tape was lowered.

The bob should be lowered with no swinging. If the bob is swinging with a circular motion, too large a reading may result.

All movements of the tape before the reading is taken must be down; and all movements of the tape after the reading is taken must be up. If this is not done, the ullage taken will be too small. The reason for this is that the oil mark on the bob shows only the minimum distance that the bob's zero mark was above the surface of the oil; and therefore it is essential that the tape be read when the bob is in its lowest position.

If the oil mark on the bob is found to be biased, the bob was probably resting on the bottom of the tank or on a submerged frame and the ullage will be too large. In this case another ullage should be taken using a few inches less of tape.

The ideal thermometer for taking the temperature of the tanks is one with graduations to every degree on a large copper scale, and with a bulb enclosed in an open cup. The standard navy issue is not satisfactory because the graduations are generally for every two degrees, the narrow painted scale is very hard to clear of the oil, and the thermometer must be lashed in a paint pot or improvised bucket to prevent the temperature of the air from affecting its reading while it is being drawn out of the oil and while the scale is being cleaned.

Most commercial companies take the temperatures of all their tanks and apply a temperature correction to the volume of oil in each tank, although some are content to take the temperature of only one tank and to assume that it is the same for all the others. After the laborious process of taking the temperatures of ten tanks (all of which happened to be full) on a commercial tanker, the author was convinced that there was practically no variation in temperatures of the different tanks under normal conditions. However, on the suggestion of Lieutenant G. W. Clark, U. S. Navy, temperatures were taken in a full tank on the sunny side of the ship and a half empty tank on the shady side of the ship. The results were such that it seemed probable that the temperature of no tank was uniform throughout its depth. This was investigated; and it was found that the temperatures at the bottoms of the tanks were that of the sea water while the temperatures at the surfaces of the oil were apparently determined by the weather conditions acting upon the above water portions of the tanks and by the distance that the surface of the oil was below the top of the tank.

Theoretically this is what might have been expected in a climate where the air is warmer than the water. Oil is a poor conductor of heat; and as the heat is applied at the top of the tank, no convecting currents are formed. Whether or not the temperature is uniform in a climate where the water is warmer than the air or in a tank which is heated by steam, the author has had no opportunity to determine. Also the author has been unable to determine if the temperature varies with the horizontal distance from the side of the ship although this seems to be probable. Any one desiring to investigate the temperatures in a tank can easily do so by lowering a maximum and minimum thermometer, such as is used in a magazine, to various depths in the oil.

From the above it seems probable that the best method of applying temperature corrections to the oil is to apply a separate correction to each tank based on the mean of the surface temperature of the oil and the temperature of the sea water.

It is interesting to note that there is a pneumatic instrument installed on most large ships, whereby the hydrostatic pressure at the bottom of the tank is shown on a column of mercury. There is a scale at the side of the mercury column which shows the

height of the oil in the tank. This instrument has the advantages that the soundings can be taken very rapidly, that they can be taken fairly accurately when the ship is rolling (which cannot be done with a tape), and that if the scale is made out correctly no temperature correction would have to be applied. However, it has two fatal defects which are that it is a delicate instrument and that the manufacturing company does not furnish sufficiently detailed drawings to enable it to be overhauled by a ship's force.

In conclusion the following odds and ends are offered. The measurement of oil is not an exact science, but the average error in fueling a small ship should not be over 600 gallons. Most commercial companies expect more or less large losses. One company was protected by Lloyd's; but as their tanker had no tables to convert their soundings into gallons, they and the insurance agent could only take the Navy's figures on the amount of oil transferred.

DISCUSSION

A Further Discussion of Naval Organization from the Industrial Point of View

(See Page 1519, August, 1926, PROCEEDINGS)

CAPTAIN C. A. ABELE, U. S. NAVY—Boiled down the author of this article argues for the control of navy material matters by a corps to be called an "Engineer Corps" or an "Industrial Corps" which corps is to be dominated by naval constructors.

His fetish is "Production." Quoting from paragraph six—

> Engineering, in the broad sense, has two branches, namely: production and operation. . . . . The major part, in the strictly professional sense, is production.

Production in the Navy is entirely a minor consideration. Military efficiency is our goal. Anything that does not tend toward that goal should be surrendered to civil endeavor.

Quoting from paragraph eleven.

> . . . . the member of a corps trained to the thought that his value to the government lies in production engineering, will be satisfied to continue his regular duties in time of war.

Does this mean that the author feels that naval constructors have lost interest or faith in their profession and want to shift to other pursuits?

Quoting from paragraph twelve.

> There is another strong argument for a large and separate production engineering group, based on the consideration that there should always be a strong minority ideal in every organization to act as a balance wheel on the majority. The line, while possessed of the highest ideals, after all is only human and the writer considers the maintenance of such a minority point of view [absolutely necessary also to insure segregation of criticism] especially a need in a military organization in a country where the military function is fundamentally conceived as being subordinate to civil authority.

This would indicate a lack of conception on the part of the author of what the Navy is and what its mission is. In the execution of the Navy's mission there is plenty of minority opinion. But when policies are settled, certainly loyal coöperation is what is then wanted; and not a strong minority in "production" to wrestle with. This would seem to be a perversion of the use of the terms "majority" and "minority," and it further intimates that production is a military function.

Quoting from paragraph seven.

Efficiency growing out of criticism only is not of the ideal type but it is incumbent on the Navy to conserve every possible incentive to efficiency, and criticism is one of the most important . . . . and the ideal organization for the Navy is one which recognizes it [criticism] at its true value and provides a segregation of activities so that criticism by the user shall land absolutely and without the possibility of evasion upon the producer.

Herein the organization of the Navy is to be based on other grounds than the efficiency of the Navy a *reductum ad absurdum.*

Quoting from paragraph twenty-one.

The proposed corps might be logically referred to as either the engineer corps or the industrial corps.

This sounds very much like Trotsky's labor battalions.

Quoting from paragraph twenty-three.

The two conditions necessary in the Navy to insure the highest efficiency of the various individual specialties are: first, some common concept or ideal sufficiently strong and universal within the group to which the specialist belongs to give appreciation on the part of all the members of the group of the need for freedom of each specialty to develop and to function freely; and, second, a group large enough to constitute a strong minority in professional ideals as compared with the line. This common concept in the proposed engineer corps would be supplied by the common ideal of production engineering. . . . .

The good of the Navy and the safety of the nation should be the concept of all officers of the Navy. Unfortunately, it would appear from what the author says that in the shore-staying corps, other motives will govern. After a careful perusal of the elements the proposed corps is to be composed of, and an evaluation of the inducements held out to gain adherents to the planned organization, it would appear that the idea in view is the creation of an eleemosynary institution as the haven for those holding commissions in the Navy who wish to avoid going to sea with its attendant responsibilities.

Quoting from paragraph twenty-seven.

The line as the ultimate means of making the fleet effective as an operated agency should dictate policies and should enunciate the ideals which the material should meet but, having done that, it should leave the technical details of providing the material to be worked out as a strictly production engineering problem under production engineering specialists but still subject to operating engineering criticism [inspection] of results.

These are high sounding words, "production" pertains to the civil establishment. Any production by the Navy should be technical and non-competitive. For that a corps does not seem necessary. Technicists, consultants, and inspectors would seem all that is necessary.

Quoting from paragraph twenty-nine.

> . . . . the aides [referring to aide for operation, personnel, and material advocated in paragraph twenty-five] would represent the technical naval organization, having nothing to do with politics and actuated by the ideal that technical results in the extreme event of war would be more important to the nation than absolute economy at any time but with the element of production engineering effectively represented both as a means of obtaining the most efficient tool for the nation's naval protection and as a means of obtaining it at the smallest practicable cost to the nation.

This is rather involved, but it is understood to mean that "Production Engineering" as described is to participate with operation of the fleet and personnel of the fleet, on an equal footing—that is, that these three are to be co-equal— and the co-equal material division is to be headed by an officer who has not the vision, ideals, nor concepts of a naval officer; but as stated in paragraph twenty-three—

> The two conditions necessary in the Navy to insure the highest efficiency of the various individual specialties are: first, some common concept or ideal sufficiently strong and universal within the group to which the specialist belongs to give appreciation on the part of all the members of the group of the need for freedom of each specialty to develop and to function freely; and, second, a group large enough to constitute a strong minority in professional ideals as compared with the line. This common concept in the proposed engineer corps would be supplied by the common ideal of production engineering. . . . .

This minority is to be a counter-balance apparently to the operation and personnel aides. In the prosecution of war as well as in the routine of peace such a minority would be a mill-stone around their necks rather than a counter-balance.

Quoting from paragraph thirty-two.

> It would be exceedingly important that material production and maintenance should be absolutely under the cognizance of the material division by law but this does not mean that in minor cases the material division should not delegate the performance of minor production and maintenance functions to the head (not to any subordinate) of a particular operative establishment. This would always be the condition insofar as maintenance of equipment afloat by the ship's force is concerned but in all such cases the material function should rest in the immediately responsible senior.

Herein a naval constructor proposes to dominate all repairs of the Navy ashore and afloat graciously permitting the forces afloat, through the senior officer present, to effect necessary repairs.

In paragraphs nine and ten the author tells us by indirection that the naval constructor is the super-specialist in production.

In paragraph thirty-four the author proposes among other things that the material officer shall take over the material matters of the Marine Corps—a wide reach!

Relative to the assignment of officers to the proposed engineering corps the following is noted from paragraph forty-one:

(j) If he then still chooses to follow his specialty, commission him in the engineer corps provided he is recommended for it by all his commanding officers both line and staff. Otherwise, unless the Chief of the Division of Material recommends to the contrary, do not assign him to the corps.

(m) Give to all line officers of not less than nine and not more than twelve years commissioned service the privilege of transferrinig to the engineer corps as extra numbers and without loss of rank or precedence provided their transfer is recommended by the Chief of Material and provided they pass a satisfactory examination before a board composed of officers of the engineering corps.

Herein the author proposes that the Chief of Material shall dictate by negation to the Chief of Personnel his "co-equal" among the aides, in personnel matters. The Chief of Personnel's job would be worth just about a plugged nickel. Furthermore it is proposed that the line shall be a dump for such officers as the Chief of Material may not want. This idea is not new, it was suggested in connection with the proposed independent air corps drawn up last winter under the egis of naval constructors.

Fortunately, a little investigation by the Office of Naval Intelligence can shed some light on the practicability of such a corps as the author suggests for adoption in the U. S. Navy. The Russian Navy had what was called its *Guard d'Equipage.* From information received from a former Russian officer of long experience, it would appear that the proposed engineer or industrial corps is quite similar to the Russian *Guard d'Equipage.* This organization comprised all the shore staff branches of the navy and handled its material.

Russian sea-going officers claimed that the *Guard d'Equipage,* due to its lack of understanding of the needs of the navy, its dictatorialness, dilatoriness, and its resultant failure to coöperate, was responsible for the Russian Navy's defeat in the Russo-Japanese War. The sea-going officers immediately after that war set themselves to the task of breaking the power of the *Guard d'Equipage.* By the outbreak of the World War this had been accomplished and as a result the Russian Navy acquitted itself with distinction up to the time of the Revolution.

Surely a system of Navy organization and administration which brought such disaster to Russia can be of no interest to us, except as a warning.

"Production" is a function of the civil establishment. The Navy's business is military. "Production" fostered by the Navy will gain it few friends and probably many enemies, as has been amply demonstrated in the case of aircraft production at the Philadelphia Navy Yard during the recent aircraft investigation by Congress. Production should not be carried on by naval

officers. Experimentation and repairs are legitimate functions. No matter how we blink the facts, the German Navy was the Navy par excellence of its time. For each dollar the German's put into their navy they got a dollar's worth. Industrial matters for the German Navy were handled by civilians.

Approval has been given to internal criticism by the author. It is of course polite to call it "criticism" among ourselves, but Congress and the public call it "bickering." We have already in the Selection Law sufficient cause for bickering without asking Congress to give us more. A weary Congress gave us that law so that the Navy could keep its troubles to itself instead of pouring them on the Congress.

The Germans had selection out and did not fill their Navy with sore heads, a condition that is growing in our Navy which is not a good portent to the service or the nation.

A house divided against itself cannot stand.

A Destroyer Leader for the United States Fleet

(See page 1111, June, 1926, PROCEEDINGS)

CAPTAIN J. K. TAUSSIG, U. S. NAVY.—In the several discussions in the September number of the PROCEEDINGS anent my paper on, "A Destroyer Leader for the United States Fleet," it is pleasing to note that in at least one respect there is unanimous agreement on the part of those who submitted suggestions and criticisms. This is in that *we do need the leaders.*

As might be expected, there was some criticism of the general features of design, and especially in regard to size and gun power. If the reader will forbear with me I would like further to discuss these matters.

Captain Dinger suggests a smaller vessel,—one of from 2,000 to 2,400 tons displacement as being capable of filling the bill. The desirability for the smaller vessel is based primarily on a less expenditure of funds. In my original paper the question of funds was neglected, the arguments being based entirely on military characteristics.

I take for granted that Captain Dinger's arguments in support of the engineering outlay for his small leader are sound. But I cannot agree with him in certain other respects:

(1) This small leader will be considerably inferior to the small cruisers which the Japanese are using as leaders, and to the new, 3,100-ton French leaders which are soon to be laid down.

(2) While the three single six-inch guns are widely separated, they would need spray and wind shields to be efficiently served. The combined weights of these shields would probably be as great as the weight of the two light turrets which would cover four

guns. The after gun is entirely too low and too far aft. Experience at sea has proved that this gun position, which looks all right theoretically, is very bad practically. And it is probable that with this small displacement, and the middle gun installed in the high position as shown in the sketch, the stability would not permit of raising this gun to a suitable height.

(3) To place only two triple torpedo tubes on any vessel of this type would be a decided step backwards.

(4) The displacement of this proposed design is *not* sufficient to give a sufficiently steady gun platform for six-inch guns and to provide for sufficient living spaces for officers and crew. Nor will it permit the necessary facilities for directing a large number of units.

(5) If the guns, torpedo tubes, and catapult are drawn to scale it is apparent that with a length of only 360 feet, there is not sufficient room for all on the center line without placing the bow and stern guns undesirably close to the ends of the ship.

(6) It is noted that Captain Dinger's plan gives a beam of only thirty-four feet for a 360-foot length. This is a finer hull than we have either in our destroyers or light cruisers. I am inclined to think that this would be a decided disadvantage as to sea keeping qualities.

Commander Kays apparently agrees with me as to the general characteristics of the proposed leader provided it can maneuver with the destroyers. Although he does not say it in so many words, it is apparent that he is opposed to the half measure vessel of about 2,000 tons displacement. This stand, I believe, is sound.

The point he makes about the shorter masts is well taken. It has recently come to my attention that the new developments in radio may make the high masts unnecessary. If this is so, they should be cut down.

Mr. Livingston brings up the question as to the feasibility of six-inch turrets on so small a vessel, and calls attention to the fact that on the *Omaha* class with a beam of fifty-five feet these turrets project over the side when trained abeam.

It should be remembered that when the *Omaha* class were originally designed the two six-inch gun turrets were not contemplated. They were later added to the requirements, with the result that the forward turret is farther forward and the after turret is much farther aft than would have been the case had their installation been originally contemplated. In addition the hulls of the *Omaha* class are unusually fine both forward and aft. In consequence of these two features the decks of these vessels have a width of only thirty feet at the frame where the forward turret is placed, and of only twenty-two feet at the frame where the after turret is installed. It is the turrets that make the installa-

tion of these six-inch guns on these narrow decks feasible. Without the turrets the crews would not have sufficient foot room for loading. That the turrets overhang the sides is no drawback. Instead it would seem that on a narrow ship it is the turret that makes the larger gun practical.

Mr. Prendergast's analysis of the question of light cruisers, destroyer leaders, and half leaders is most interesting. I agree with him in regard to the undesirability of the employment of lightcruisers for destroyer flagships. This should not be necessary. The flag boats of our destroyer squadrons as now organized correspond closely to what the British call half-leaders. They are not *real* leaders and are not suitable as such. It is noted that Mr. Prendergast suggests one leader for every twenty-four destroyers instead of one for every eighteen, the difference being due to his four division organization instead of our three division organization.

While Mr. Prendergast is apprehensive of the weight of the six-inch turret so far forward, it should be borne in mind that such a turret is not heavy construction but only of sufficient weight to protect against the elements, i.e., wind and spray,—and to give footing for the guns' crews. I believe that our constructors can overcome the difficulties of spray by the proper design of hull, ship control station, and fire control station.

The blinding effect of the six-inch gun when fired at night cannot be much greater than that of the five-inch. One reason for placing the guns in a turret is to get them farther from the bridge than would be the case if two guns were mounted singly so that one would fire over the other.

I cannot agree that it would be desirable to have torpedoes of two sizes as Mr. Prendergast suggests. If cold shots are necessary we should be able to make them with twenty-one-inch torpedoes as well as with smaller ones. It is better to have *all* of the torpedoes larger than necessary to sink a small ship than to have some of them not large enough to cripple a big ship.

There may be something in Mr. Prendergast's point about the location of the searchlights. However, while in a night action the searchlights might be used as a point of aim, the chances are that the deflection of the enemy's shots will be such as not to hit the exact locality of the lights.

I am inclined to agree with Mr. Prendergast in the possibility that the funnel area is not sufficient. The designers must be trusted to remedy the defect when the calculations are made. As for staying of the mainmast it would seem that the answer is to cut down the size of the mast to the dimension where it could be stayed without interfering with the after turret.

Mr. Prendergast bases his stand that the leader of from 2,000 tons to 2,200 tons is of sufficient size on British destroyer leader experiences in the World War. Now I think we in the United States would make a tremendous mistake to let this influence our judgment against the larger vessels. Studies of the Battle of Jutland clearly demonstrated that the destroyers were poorly led on both the British and the German sides. This was not necessarily the fault of the personnel. It was essentially the result of unsuitable vessels that did not permit of the higher command making the best use of the destroyers at their disposal. With all the destroyers available in the battle, the greatest number that attacked simultaneously at any time was eleven!

In watching the trend of affairs in the foregoing navies it is noted that the size of destroyer leaders gradually increases just as did and does the size of practically all other classes of vessels. We have the opportunity to build a ship that will meet all the present and future requirements insofar as can be foreseen. To build the smaller vessel can have no other results than to leave us dissatisfied and wondering why we did not obtain a big enough ship in the first place.

The Tidal Wave and Earthquake at Arica, Peru, in 1868

(See page 1319, July, 1926, PROCEEDINGS)

CAPTAIN J. K. TAUSSIG, U. S. NAVY.—I have learned through the discussion of my paper by Commander Hewitt in the September PROCEEDINGS and through a letter from Lieutenant Wylly of the *Cleveland*, which ship has recently been at Arica, that Mr. von Tresckow, the American Consul, is much interested in collecting data concerning the earthquake and tidal wave.

Lieutenant Wylly sent me copies of a paper by the late Rear Admiral L. G. Billings titled, "Some Personal Experiences with Earthquakes," which was published in the *National Geographic Magazine* of January 1915, and of a letter written by Mr. von Tresckow to Admiral Billings which was never delivered owing to the latter's death.

Admiral Billings' account is a very vivid description of the earthquake and tidal wave as he remembered it after a lapse of forty-seven years.

As Mr. von Tresckow's letter throws light on the *Wateree's* career after the grounding, and as it may lead to further information, I am sending it for publication. It is as follows:

American Consular Service,
Arica, Chile, February 16, 1923*

Rear Admiral L. G. Billings,
U. S. Navy, Retired,
c/o Navy Department, Washington.

SIR:

I have to state that as American Consul of Arica I have been very much interested in your vivid description of your personal experience of the tidal wave and earthquake at Arica in the late sixties, which appeared in the *Geographic Magazine* of January, 1915. This interest is accentuated by the fact that the river Wateree, after which the U. S. Naval vessel *Wateree* was named, flows about one mile from my native town, Camden, South Carolina.

Mr. B. S. Fry, manager of the firm of George P. Finlayson, and British Vice Consul, has a bound volume of the *Geographic Magazine* of 1915, and lends it to dozens of American and English visitors every year, who peruse your article, especially that part dealing with Arica, with the greatest interest.

What prompts me primarily to write you is the closing paragraph of your article, which reads:

> Careful survey of the *Wateree* proved that while she was practically uninjured, it would be impossible to launch her, so after removing the most valuable of her equipment, she was sold at auction to a hotel company. An epidemic of yellow fever broke up that enterprise, and the old ship was afterwards successfully used as a hospital, a storehouse, and lastly as a target for great guns during the Peruvian-Chilean war. But her gaunt ribs still rise above the shifting sands, a fitting monument to one of the greatest modern earthquakes.

I note from this that you do not know the more than remarkable later history of the *Wateree,* and I would also like to ascertain where you got your information as to the old ship being a hospital, storehouse, etc., and a target for Peruvian guns, of which tradition nothing is known here.

I will state that in the tidal wave of 1878 the *Wateree* was floated back from the position at the bottom of the hills to within perhaps 120 feet from the shore line, and would have floated into the bay had not a low sand dune obstructed her passage and held her there. Mr. Edward J. Hulman, an Englishman who has resided in Bolivia and Tacna for some forty-five or fifty years, and who in the seventies was a clerk in the house of Campbell Brothers in the adjoining town of Tacna, stated to me that while he was with that firm just after the second tidal wave, the firm through

* Returned to American Consulate April 4, 1923, Arica, Chile.

the American Consul bought the *Wateree,* sold the guns and ammunition to the Peruvian Government, that some of the guns were shipped to Lima, and that one at least was used on the Morro at Arica against the Chilean bombarding fleet in '79. That as the shells were a little too small for the Peruvian guns they put brass or copper rings around them so that they would fit the bore of the Peruvian guns. That the firm of Campbell Brothers dismantled the ship and sold the metal, and that the few pieces now remaining in the sand dune about fifty feet from the Tacna-Arica Railway are the remains of the *Wateree.* The Peruvian ship called, I think the *America,* which also was floated ashore in the first tidal wave, was also dismantled by someone, probably after the second tidal wave, as her eight fireboxes are still about midway between the bottom of the mountains and the shore.

There has been some argument here as to whether the remains of the *America* were really those of the *Wateree,* but Mr. Hulman claims that he positively knows that the few pieces of iron left near the seashore are those of the *Wateree.*

If you had a picture of the eight fireboxes of the so-called *America,* could you identify them if they were really those of the *Wateree,* or would all fireboxes be alike?

As stated above, nothing is known here of the ship's being used as a hospital, storehouse, etc. How she could be so used I cannot imagine, because she was in the desert with no water or habitations near.

You will perhaps be interested to know that Mrs. George P. Finlayson, Sr., daughter of the British Vice Consul at the time of the first tidal wave, Mr. Nugent, and her family, though born later, have had handed down to them stories of the courtesy and kindness of the officers of the *Wateree,* and the Nugent family have had a piece of furniture from the *Wateree.*

If you have the time and inclination, I should be very much interested to hear from you on the subject, as I would like to make an entry of any additional facts in the Miscellaneous Record Book of this Consulate.

Very respectfully yours,

EGMONT C. VON TRESCKOW,
American Consul

The Threshold of a New Era In International Law

(See Page 1367, July, 1926, PROCEEDINGS)

The Christian Science Monitor, 19 August, 1926. — The July number of the United States Naval Institute PROCEEDINGS contains a very suggestive article, "The New Era in International Law," by an officer of the United States Navy, Lieutenant Commander Lucius C. Dunn. It is of importance because of the

great stress it lays upon the part played in the maintenance of peace by a wider interest in international affairs. As a naval officer Commander Dunn cannot be denied his fling at "the pitiable pacifist advocates—those emotional theorists and their peace-at-any-price doctrines." But he recognizes the fact that an active and intelligent interest in international affairs by no means precludes a thorough understanding of the necessity for adequate equipment for national defense.

There is great value in Commander Dunn's brief summing-up of the essays in international coöperation during the last fifty years which have led up to what he holds to be a new era in international law. International conferences have not always assured peace. That the world knows too well. Ever since the Berlin Conference of 1878 the nations of Europe have more and more often sat around a council board, yet the cataclysm of 1914 was not averted. Nevertheless it is reasonable to believe that the more things nations have in common the less they are apt to quarrel.

Among the recent conventions are the International Postal Union, the Conference of International Sanitation, International Marine Conference, Congress for Adopting a Common Meridian, and International Labor Congress. Under the League of Nations are many conferences such as those on narcotic drugs and that on the labor of women and children. Only recently a Pan-American Press Conference was held in Washington, and delegates are now on the way to an International Press Conference in Geneva. An international commission is codifying international law, and the International Chamber of Commerce is at all times a force for the establishment of better commercial relations between nations. And of supreme importance is the preliminary conference for the Limitation of Armament now sitting at Geneva.

Commander Dunn sees in all this a reason why naval officers should be ardent observers of foreign affairs and well versed in international law. That is, however, too narrowly technical a view. The more widely knowledge of the thought and activities of foreign nations is spread among the American people the less will be the danger of those international misunderstandings which so frequently culminate in war. It is for this reason that such institutions as the Institute of Politics at Williamstown, Massachusetts, perform a true service to humanity, and it is for the same reason that the growing interest of the American press in foreign affairs is a healthful and a helpful symptom. As Americans develop the international consciousness they will lose that parochial narrowness that sees only potential enemies in foreign nations.

THE AIRPLANE-CARRIER "SARATOGA" IMMEDIATELY AFTER LAUNCH

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FROM 3 SEPTEMBER TO 3 OCTOBER

COMPILED BY

LIEUTENANT COMMANDER W. G. GREENMAN, U. S. NAVY

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UNITED STATES

Sea Power, the Navy and Commerce

Marine Journal, 25 Sept.—It is a fact, increasingly recognized by all intelligent citizens of this country, that the margin of their prosperity is coming to be more and more measured by the volume of their foreign trade. Our country has passed the development stage. Our frontiers are now the oceans. We have become a creditor nation. We have bred and otherwise acquired one hundred and ten millions of people. We have created enormous manufacturing and agricultural facilities. If our people are to maintain their present splendid standard of living—if they are to continue to be fed and clothed and housed better than any other people in the world—they must secure outlets abroad for free and profitable disposal of the surplus products of their farms and factories.

There are many countries and localities in the world that would be progressively capable of absorbing vast quantities of our surplus products. China, the Near East, Central Asia, Africa, South and Central America immediately occur to the mind.

Never Dominating

In all these places except those in the Americas, the peoples inhabiting them have not full sovereignty. There are spheres and influence and concessions. Practically speaking, there is not equal opportunity for all for trade and commerce. In the Americas there is equal opportunity. This is because the United States, rigidly adhering to the Monroe Doctrine, has effectually prevented the domination of exploitation of any American country by outside powers and at the same time has refrained from dominating or exploiting of any American country by outside powers and at the same time has refrained from dominating or exploiting these countries for her own advantage.

The United States has for three-quarters of a century endeavored to extend the principle of the Open Door and equal trade opportunities for all, to include China and other undeveloped or semi-developed localities. We are attempting to apply it to Turkey and the Near East. We have not been overly successful, and yet if we could get the principle accepted by world opinion, it would be a most tremendous forward step toward permanent world peace and stability.

The recorded history of the world from the earliest times right down to the present, presents a uniform record of nations engaging in bloody war to secure advantages in foreign trade. They have fought for concessions, for spheres of influence, for the right to solely exploit, or to dominate or to annex.

A nation like Great Britain or France, or Japan, that needed to secure additional markets for surplus products, has inevitably been forced to resort to force to get them.

The United States abhors acquiring wealth by such methods, even though they have been considered perfectly legitimate for a great many hundred years. We don't intend to seek wealth by the sword. We are willing to pay for our prosperity with the sweat of our brows and the labor of our hands and brains and not with the groans of subject peoples.

What is the alternative? We are bound to establish our foreign trade—sooner or later the energy and genius of our young men will insure that—and yet we don't want to achieve it with the sword.

Without Discriminations

The logical, the simple alternative is the firm prosecution and insistence on our right to trade freely and without unjust discriminations wherever we will so long as we obey the laws of the lands concerned. In addition, and of essential importance, we must back that principle up with seapower.

Seapower in itself is not aggressive. Coupled with great and imposing land armaments, such as were possessed by the late German Empire, it is a sign of aggression and could rightfully be viewed with alarm by other nations. Our small army and our clear record of 150 years since the Declaration of Independence is proof positive of our pacific intentions towards the rest of the world.

We don't need a great and imposing navy to achieve our ends. We don't need an overwhelming force of ships of war capable of crushing the other navies of the world. We do need a healthy, vigorous merchant marine capable of providing bottoms for at least half our trade and backed up by an efficient navy equal in force to any other in the world.

Latent Power

We have more latent power than any other nation in the world. We are for the present the richest nation in the world. If our latent power is to react to our advantage, there must be some outward and visible sign of it. Everything worth having in this world must be paid for.

No business man who expects to succeed would put his affairs in the hands of his principal competitors and expect them to administer them to his advantage and not to their own. Yet that is precisely the situation in which many of our citizens seem to want to place this country.

There are many people who want to reduce the navy to the point of impotency, forgetting that an impotent United States

must be fair game to any other nation possessed of the requisite force to dare to take advantage of her. China, with 450,000,000, is prostrate in the dust because she has not had either the ability or the will to secure the necessary degree of respect for her rights and interests by her neighbors in the world.

Navy for Protection

We don't require a navy because we expect to use it against Great Britain or Japan or France or Italy, or any other nation in the world. We do need a navy as an outward and visible sign to the rest of the world that we are prepared and ready to sturdily and fearlessly support our just rights and the just rights of the least of our citizens whenever and wherever they may be jeopardized.

"When a strong man armed keepeth his palace, his goods are in peace.

"But when a stronger than he shall come upon him, and overcome him, he taketh from him all his armor wherein he trusted, and divides his spoils."

Jesus Christ spoke the words quoted above, as reported by St. Luke, nearly nineteen hundred years ago. The philosophy then expressed is strictly applicable to the needs of the United States today.

A sturdy, self-reliant United States, adequately armed to support justice and right, need have no fears for its future security and prosperity.

A weak, slothful United States, impotent to either defend its borders or advance the lawful interests of its citizens need have every fear for the future.

The one inevitably would prove an unsurpassed force for preserving the peace and stability of the world. The other would inevitably jeopardize that peace and stability. Great wealth that is defenseless, always is provocative of attack, whether it be possessed by a nation or an individual. We have countless examples to prove that statement both in the history of nations and the history of individuals. It must never be forgotten that history always reacts itself.

Comparison of our seapower with that of Great Britain and Japan indicates that the United States is a second-class seapower, and moreover, a second-class seapower that more nearly approaches the third-class seapower, Japan, than it does to the first-class seapower, Great Britain.

So long as we remain a second-class seapower, we remain a second-class commercial power.

We can never develop a foreign trade second to none other unless we secure that foreign trade with a merchant marine and a navy second to none other.

We can never insure ourselves from violent dislocations of our economic fabric caused by wars in the world, even though they may not directly concern us, unless the outward and visible sign of our seapower is so sturdy and secure that no conceivable belligerent or set of belligerents dare incur our displeasure by trifling with or jeopardizing the just rights and interests of our people.

Remember that seapower is not aggressive and is primarily defensive.

It may be asked, what will it cost to become a first-class seapower? Are we not already groaning under a crushing load of taxes to maintain the seapower we have?

TAXATION STATISTICS

The crushing burden of taxation, when closely examined is a good deal less than many people suppose. Although there have been no exact statistics since 1922, the average citizen of the country pays each year in taxes for the support of his town or city, county, state and the federal government a total of approximately $70.00. Of this total amount, four per cent or 2.82 goes to support his navy. This is the crushing burden of taxation citizens are asked to bear on account of the navy.

Another dollar per capita per year, wisely expended, would in from seven to ten years put us far on the road to a seapower the equal of any other in the world.

Undeniably it is a great deal of money—about a billion of dollars spread over ten years—but it will be the best and most profitable investment this country or any other country ever made. Our citizens in the factory or on the farm will get it back in increased and secure prosperity an hundred fold.

If we don't spend it, the republic won't fall in ruins—but there will be real and pressing demands from our people to explain their waning fortunes.

Politics for Legionaires

[Address by Major General James G. Harbord, President of the Radio Corporation of America, before the State Convention of the American Legion of Kansas, at Fort Scott, Kansas, September 8th, 1926.]

As one whose early life was passed in Kansas I feel an especial pleasure in appearing before the American Legion of this state. My father and mother settled on a prairie upland claim in the northern end of Lyon County in 1878. When I was sixteen I entered the Agricultural College at Manhattan, and after graduating there in 1886, I taught school in Butler County, near El Dorado, and at my college until I enlisted in January 1889. Teaching a

country school was about the only thing a raw graduate could do in those days. As an additional claim to your consideration I am president of the corporation which employs the first Adjutant of the American Legion of this Department,—Major I. E. Lambert,—and we are glad we have him on the rolls. If he worked as well for you as he does for us, you should never have let him leave the state. As an officer of the American Expeditionary Forces in France I know of the red-blooded gallantry with which you men of Kansas fought on the Western Front. Yours was a record which made me proud to hail from the same state.

It is almost eight years since you returned from France with your well-won honors and took up the duties of civil life. Nearly sixty years before your time another great American army marched home from a war. With the problem of demobilization before them in 1865, there were many who wondered if so large a body of young men, trained in the habits of war, could be disbanded and absorbed in the civil population without grave dangers to our institutions. There may have been those who felt similar apprehensions in our day, but in 1919 as in 1865, the returned soldier at once took rank among his fellow citizens as an exponent of law and order, as an example of industry, and as an anchor of stability in his community.

In your turn, even as it happened to your fathers, you have been and will be courted by the politicians. Paralleling the great veteran organization to which your fathers belonged,—the Grand Army of the Republic, of blessed memory—you are destined, in spite of the non-partisan, non-political character of the American Legion, to play a paramount role in American politics for more than a generation, to receive high political honors individually, and within the next fifteen years to dominate both the state and federal governments. That time will find you in a majority in both Houses of the Congress, and in the Cabinet, and with one of your number in the presidential chair.

As veterans, once skilled in arms and disciplined as soldiers, you are at once an asset and, in one sense, a liability to your country. Your responsibility for the national defense is as great but no greater than that of any other citizen, whether he be grown to manhood since the Great War, or was one who performed necessary and honorable service in civil life during that conflict, or be a surviving slacker apologizing to his children for his war record. No greater responsibility, that is, except for your better knowledge of what war is, of the necessity for training and adequate preparation, and of the strain which war lays on the souls of men and nations. Your days in the front line, if unhappily there were to come another war, are ended. This state-

ment may sting your pride in your strength, and temper your joy in the prime of manhood which is still yours, but it is a fact. The army which saved the Union was seventy-five per cent of it under twenty; your memory will tell you that over eight years ago the majority of your World War comrades were under twenty-five, yet your existence and the theory that you are good for another front line experience if we had another war, are the arguments used by politicians and pacifists, and sometimes they are found in the same camp, as a justification for a lack of preparedness. You did the trick so well the last time that they are willing to have you do it again.

My judgment is that your great value to your country lies now not in your potentiality as front line troops, but in your good citizenship as graduates from the School of War. Your importance in the politics of this great country is as inevitable as the rising of the sun. It is you who must so shape your country's policies, foreign and domestic, that the probability of another war will be minimized not only by suitable and adequate preparedness as insurance against it, but by bringing to governmental institutions the disciplined system, efficiency and steadiness which enabled you so well to do your part in that brave summer and autumn of 1918. A bankrupt diplomacy and self-serving statesmanship were responsible for the World War. Foch, Pershing, Haig and Petain, with Hindenburg and Ludendorff and half a dozen stenographers, a few maps, a minimum of so-called "experts," in a month's time could have made a more enduring peace for the world than was accomplished by the conference of statesmen which sat in Paris for two years and played and plotted with the possibilities which were created by the valor of the armies. In your discharge of your duty as citizens and that of your surviving brothers of the Allied armies, and of the armies with which you contended, lies the hope of the world of our time. The friction and bitterness in the world today, the soreness and the jealousies are not of your creating, but in the solution of the situations from which they arise, your citizenship will find its opportunities. In your fast approaching day of power and place, your opportunities will carry with them grave responsibility.

There are many conditions in our country which should cause you thought for the future. The foreign red and the domestic yellow are alike industriously inimical to our free institutions. With an oversold market for government statutes there are forty-nine law factories, one federal and forty-eight state, working overtime in mass production of laws. A deplorable cynicism prevails towards our national legislature. With our President and Congress striving desperately for economy in government, the

appropriations made by this Congress exceeded those of any other that ever sat in time of peace. In 1871 there was one civilian employee of our federal government for each 733 of our population; in 1921 there was one such employee for every 192 of our people. Since that date the numbers of such employees, due to prohibition and other new activities, have tremendously increased. In 1871 our national debt, excluding expenses relating to the recent war, was $1.58 per person; in 1921, excluding similar expenses, it was $7.64 per head. In that fifty years the total cost of the peace activities of our government increased more than fourteen times; our population increased about two and a half times; the number of civilian federal employees increased over ten times, from 53,900 to 560,863. On July 1, 1926, there were 560,705 persons on the government payrolls in and out of Washington, and yet one of the most outstanding grievances recited against George III in the Declaration of Independence was that: "he has erected a multitude of new offices and sent hither swarms of officers to harass our people and eat of our substance."

These are days when you hear much about a disregard for law, usually in connection with the Volstead Act and its violators. Not as often do you hear of the disregard of the Fifteenth Amendment in the South, and even more seldom of the cynical way in which Congress disregards the direct mandate of the Constitution to apportion the House of Representatives according to population as shown by the ten-year census. To do it would cost some congressmen their places and lessen the importance of certain states and perhaps increase urban at the expense of rural representation in some regions.

Our people seem to have lost their sense of proportion. The fine welcome that greeted you on your victorious return from the war, has within six months been extended by the same people in the same way to the royal Swede Gustavus Adolphus and to Bobby Jones, and to others, each of whom in his turn has been escorted up Broadway, preceded by platoons of police and followed by a battalion of doughboys and blue jackets, not to mention a few marines. Uplifting has become a profession. Busy little executive secretaries, all on salary, representing associations of wealthy and well meaning meddlers with a sprinkling of insidious internationalists of every political shade from pale pink to blood-red, issue floods of literature on every phase of human interest. Pacifist organizations opposing preparedness for national defense, and almost always allied with those who seek to replace patriotism with internationalism, are stimulated by the same interested and profitable machinery of endeavor. Some of the churches appear no longer to concentrate on the saving of souls, but have gone into

politics and governmental policy on a scale which seriously threatens our traditional attitude on the separation of church and state. Propaganda is the order of the hour. The testimony before Senator Reed's committee investigating corruption in primary elections showed the expenditure by the Anti-Saloon League within the last few years of sums so vast that an individual or a business corporation, or even a church that equalled them would arouse the instant alarm of the whole nation. Yet I doubt if one tenth of one per cent of our people have ever favored the return to the open saloon of other days. Nor does the dampest of wets ever claim advantages for drunkenness.

The so-called "youth movement" imported from Europe to the United States raises rebellion among young people against parental and other restraint. Boys and girls of college age are taught that tradition and experience are valueless beside the inspiration of class-conscious youth. The child labor amendment to the Constitution had the support of communists because it gave to the state complete control over youth during the impressionable period, the ultimate aim of the communist being to make all children wards of the state. The youth movement is well recognized as an instrumentality of bolshevist training.

With the evils of paternalism so well exemplified within the last few years in the goverment of our British cousins, our Congress, instead of devoting itself to functions that cannot be handled by the states as was contemplated by the writers of the Constitution, is being forced by social welfare propagandists into legislative invasion of almost every phase of police power reserved to the several states. Our daily conduct from the cradle to the grave, including what we eat and drink, what we buy and sell, what we read, what we may see at the theaters, how our wives shall divorce us, whether we shall hunt and fish, see prize fights and go in for physical training; how our mothers shall be advised in case we are not wanted in the world, or how our arrival shall be expedited if we are desired, are all matters that are suggested for statutory treatment by Congress.

Such are some of the conditions which, in my judgment, give you your opportunity. While the foregoing arraignment may sound somewhat pessimistic, the old ship of state is far from being on the rocks. The alarm to be felt is not so much at conditions as at the indifference, ignorance, and neglect of the ordinary duties of citizenship, which have brought them about, and without which they cannot continue.

If I were to diagnose the principal shortcomings of the average American voter I think I would define them something as follows:

(1) His indifference. He has allowed himself to be saddled with a primary system to which he pays little or no attention. It

makes for corruption, for increased expense, and has resulted in a lowering of the average capacity and character in the candidates selected. The average voter does not attend the primaries, which are therefore manipulated by the sophisticated few who attend them for reasons of self interest. Only wealthy men can aspire to high office under the primary system. Neither does the average voter go to the polls on election day. Only fifty per cent of the qualified vote of the United States can be depended upon to turn out for elections. Your governmental business thus neglected by you gets into the hands of those who do not neglect it from their standpoint, who make a profession of it, and their interests are seldom identical with yours.

(2) The average American voter, keen as he may be about ordinary business matters, is carried away by a fine line of political talk, and accepts without investigation what the political leaders tell him. Absorbed in his own business, his unfamiliarity with political theory inclines him to look on legislation as a remedy for all existing political ills. His first instinct in such matters is to demand a law. With the statute on the books he considers his duty done, not being particularly concerned with its execution. Those of you who had much dealing with our French Allies will remember the familiar phrase, *C'est ecrit,*—it is written. That was the excuse for anything which a Frenchman did not wish to change. The bridge was built when the blueprints were finished. We are not very different from that in our attitude toward political issues. We think a law can do anything. Many earnest Americans believed that the Eighteenth Amendment, once passed, would not only bar liquor from our borders, but would cure the thirsty of desiring it. Tennessee passes a law against teaching evolution, and expects by it to paralyze the trend of thought and kill the desire for knowledge. Others want a uniform law for divorce, expecting the very complex relationship of marriage to be solved by it. Such a law would be adapted to South Carolina where there is no divorce, as well as to Massachusetts where there are seven recognized grounds for it, or Nevada where marriage ties are said to sit very lightly. Pass a law and the average voter expects it not only to regulate human conduct, but to change human nature. It is no wonder that with this attitude of the voter our forty-nine law factories are working overtime.

(3) The average American voter does not take the trouble to have an opinion on the foreign policy of our country. There is certainly no body of our citizens so well qualified to have an opinion on dealing with our late Allies as the four millions who wore the uniform in 1918, and especially is this true of our more than two millions who wore that uniform across the seas. Yet how many of them, how many of you, have given voice to such thoughts as you may have on the foreign debt settlements or at-

tempted to influence their course? You have permitted a settlement to be offered to France that will bring to your grandchildren the accumulated ill will of sixty-two years. One wonders if our Debt Commission, in making that deal, had in mind the fact that a million and a half of the very flower of French manhood lie beneath the sod—dead that France might live—dead hundreds of thousands of them, in holding the line while we prepared for our part in the War with Germany, after declaring it.

(4) The average American voter gives little consideration to the rapidly changing character of our government. Few documents in the history of the world have received as much praise as the American Constitution. Presided over by George Washington the convention which adopted it composed the very cream of the colonial intellectuals, and their highest types in character, and labored four months in its formation. Read over in our day it reveals no special mark of divine inspiration and many a modern corporation lawyer plumes himself that he could write a better one. Confederations of states were almost as old as human history. Pure democracy had already caused the ruin of more than one great empire. Nations had for centuries been subdivided into administrative entities. Our claim to originality lay in the creation of a nation dealing directly with its people and yet composed of sovereign states, independent in certain fields and functions. The greatness lay in the fine adjustment of the powers of government, assigning certain of them to the federal government and reserving others to the states. The powers of national character such as foreign relations, management of the military establishment and responsibility for the national defense, interstate and foreign commerce, monetary systems, postal facilities, patents and copyrights, were conferred on the new federal authority, and *all* others were specifically reserved to the states or to the people themselves. Local government for local affairs, federal government for national matters. It was, and if it yet functioned as designed by the fathers, would be still, the best machinery yet devised by man for the maintenance of a nation without destroying or minimizing local self-government.

The Constitution was formed by representatives of independent states, jealous of each other and of their rights, yet realizing the necessity for a more perfect union. The new states had been colonies under a centralized monarchy, and they feared the loss of their liberty through encroachment by the central government which they were met to create. The Constitution was drawn to limit to a minimum the functions needed for the national welfare. There then existed no national self-consciousness. That has come with the passage of the years, with the demonstration of the need for a strong central government in our foreign relations, and as a reaction from the Civil War. The descendants of the original

colonists form but a small fraction of our present population. Millions of immigrants arriving since 1789, and their descendants constitute the majority of our population. Whereas state sovereignty meant patriotism and tradition to the voter of Washington's time, it has no such significance to the descendant of nearly a century and a half of emigration. When the immigrant sought his fortune in the new world it was to America he came, not to Maryland or Massachusetts. He came to the nation, not to a state, which meant no more to him than Touraine or Normandy means to the Frenchman of our day—merely an administrative unit.

As the states have developed unequally, due to difference of climate and natural resources, some have become wealthy and others have remained poor. Meantime, the nation has grown rich. States have sought federal aid and state officials have surrendered state prerogatives for federal appropriations. Rivers and harbors, the extension of the Departments of Commerce, Agriculture, great reclamation projects, and public highways have been the pottage for which many states have sold their birthright. To a poor state with poor roads the opportunity to receive federal aid for highways by raising an equal sum itself, is a temptation to which many yield, no doubt conscious that the federal aid is made up by taxes raised in more prosperous and more populous states. Railways have drawn the states together and the necessity for their unified control has practically obliterated state boundaries. Treaties with foreign governments have also played a part in the changing attitude toward the Constitution. There has been a steady adaptation by Congress of old powers to new ends. The regulation of interstate commerce has been the vehicle which has brought us the great mass of trust-busting legislation, Pure Food and Drug Law, the suppression of lotteries, and limited transportation of prize fight films. The same vehicle has brought us the Employers' Liability Act, Child Labor laws, White Slave Act, Hours of Service, etc., etc.

Summarizing, the defects of the American voter against which I would warn you are his indifference, his tendency to let politicians 'put it over' on him and to look on mere laws as a panacea for any condition that requires remedy, his neglect to make his influence felt in our foreign policy, and the slip-shod manner in which he has permitted the central government to drift into legislation inappropriate to the dignity and efficiency of a great nation, and ruinously wasteful and extravagant. With the encroachment on the state powers and the propaganda of active organized minorities ours is no longer a representative government, but a government by delegation. Once chosen because they were the representative men of their communities whose judgment could be trusted to act for the common good, the primary has so lowered

the quality of our Senators and Representatives that they often vote under the lash of popular displeasure. Sheafs of telegrams on every congressmen's desk tell him almost daily how he is expected to vote and he no longer represents—he merely obeys. With the atrophy of state legislative power and the pressure of propagandists on the national congress it is fast coming to resemble the British Parliament, which in the absence of any lower legislative authority corresponding to our state governments, may legislate one day on dog ordinances for Manchester or Liverpool, and the next on some great question of policy for the empire.

As to your duty to attend the primaries, if we continue to have them and your obligation to vote, there can be no debate. The success of a self-governing democracy depends upon the intelligent interest and participation of its citizens. On matters of foreign policy there is no doubt that your influence should be felt. It is the lamest part of our government. We really have had but one stable foreign policy—the Monroe Doctrine which many of us do not now know how to define and which has existed for over a century with the moral support of the British Navy.

With reference to the changing character of our government, the diminishing powers of the states and the consequent entrance of the Federal authority into our daily lives in a manner not only never contemplated but actually forbidden by the Constitution, there are two viewpoints. Those who foresee the fatal results of such a departure from the faith of the fathers and desire it because they wish to see our institutions overthrown, plus those to whom social betterment and the uplift are the principal ends to be sought in government and who believe that the federal government will be more efficient in such matters than the states, and more easily manipulated because centralized instead of scattered, all hold one view—they wish to see an end of state sovereignty and all powers of government, police and otherwise centralized in the federal government to whom may be added the great army of commissioners, members of boards, prohibition agents, employees of bureaus, and other numerous beneficiaries of such activities. Against them are those who believe in the Constitution adopted by the Fathers with all its system of checks and balances preserved, and federal and state governments each sovereign in its own constitutional sphere. They resent the multitude of extra-constitutional agencies such as boards and commissions, believing that the powers of government are executive, legislative, and judicial, and that the Constitution provides adequate machinery for the government of a free people. To them the encroachment on the state powers is not only hateful as subversive to our liberties, but means the eventual failure of our government. They look on governmental paternalism as the straight path to state socialism. This path once entered leads only to state standardization of men and

morals. It is the end of that individualism which has made us what we are and which has been our proudest boast. It opens on a vista wherein there will be federal control of our daily lives and conduct from the cradle to the grave with restrictions of every sort administered by Washington bureaus and enforced by federal officials, affecting everything that we enjoy and all that we do. It reveals a federal government duplicating the action of the several state governments with double overhead, double enforcement machinery, with double the personnel, and more than double the expense, and two sets of statutes on the same subjects. No federal government bureau ever created has failed to attempt to extend its field and aggrandize the importance of the politicians who operate it. The army of civil employees is forever being recruited and reenforced. As the federal government invades the home, the business and the private lives of our citizens, it will become more unpopular and less respected. Different sections of the country will develop animosities and the sectional alignment of parties will become even more marked than it has been with sixty years of the "solid South." The outstanding instance, of course, of federal encroachment in the legislative domain of the states is found in the Eighteenth Amendment and the Volstead Act so generally disregarded and so incapable of enforcement by the federal government. One does not need to quarrel with prohibition or to desire the return of the saloon to believe that this is a matter which should, by right, be left to the legislatures of the several states.

The integrity of the state was a cardinal principle of our government when it began to function. Is it possible for a central government to regulate and supervise the daily lives of a hundred and ten millions of people without becoming top-heavy? Is it possible with an electorate as mixed and heterogeneous as ours and with such diverse needs? Shall the conduct of citizens of Kansas be prescribed by congressmen from Rhode Island or be supervised at the expense of the taxpayers of New Mexico? Is the Constitution hopelessly out of date or is it still the best charter of government yet devised by the mind of man? These are questions which each returned soldier, each Legionaire must determine for himself. We are near the parting of the ways. As for myself I am for the Constitution and believe that we should take the path that returns to it, forcing Congress to abandon the field to petty police regulations to the local self-governing states, and to concern itself with truly national problems. If I am to be regulated to the point even of oppression I prefer it to be done by my own state rather than by the senators and representatives of distant and different peoples.

I commend these matters to your consideration. Your judgment can be trusted as much today and for the future as when

you wore the uniform of your country. Take political leadership into your own hands. Live up to the responsibilities and the opportunities that are yours. There can be no fear for the future of our country when it is governed in peace by those who fought for it in war.

The Launch of the United States Airplane-Carrier "Saratoga"

Shipbuilder, September 1926.—The *Saratoga* was launched from the Camden yard of the New York Shipbuilding Corporation on April 7, 1925, and is, the author believes, the heaviest warship on record.

A number of points had to be most carefully considered, and every allowance made.

The building berth gave a depth of water over way ends at normal high tide of only 8′ and 6″. Many calculations were made to ascertain whether this was enough to avoid damage to bottom from excessive way-end pressure. It was finally settled that extension of the ways was necessary and justified in order that sufficient machinery could be installed below, so that the structure could be well closed in and riveted to give proper strength. The ways were extended on piles for 75 feet further in order to get 11′ 10″ of water over way ends at a normal high tide.

For a distance amidships the longitudinals directly over the ways were filled in with electric welding to get a metal bearing between shell and longitudinal and so relieve the rivets here from shearing stresses in way of maximum way-end pressure. As this was thought of in the early stages, it was easily done at little expense.

Checking after leaving the ways has now for the first time been a real problem at the Camden yard. The Delaware here is wide and this yard has never before faced the checking problem seriously, though in all large and moderate-weight launches an anchor is made available as a precaution in case tide or wind gets the best of things before the tugs get control.

In the case of the *Saratoga* very definite checking arrangements were made; they consisted of both dropped and previously placed anchors.

Owing to the small declivity, there was a feeling in some quarters that the speed would not be excessively high. Calculations were made for two coefficients of sliding friction between ways, *viz.*, 0.02 and 0.03, and in each case water resistances were estimated and added by successive increments as the vessel progressed down the ways, allowances being made for both locked and free propeller wheels, the friction of the sliding ways and for various stern masks. These calculations were admittedly approximations, but they clearly indicated a possible speed on leaving the ways in

the neighborhood of 20′ per second. The observed speed on leaving the ways was 22′ per second for the *Saratoga.* The actual speed curve was very near to the calculated; they cannot be too closely compared as the weights, masks, and wheel conditions that finally obtained were different from the assumed conditions. The confirmation of these figures was remarkable, and the builders now feel assured that they gave a true indication.

This vessel has four very large propellers. Doubts as to the reliability of the speed estimates very naturally obtained; these indicated both the safeness and the desirability of locking the wheels, but the possible undue slowing up of such a long vessel on the ways under pivoting pressure was not to be lost sight of. For this reason, a special brake was secured to each shaft, consisting of a large winch barrel and heavy manila rope brake operated by dropping a weight to apply friction to the drum. These weights were released by cutting ropes on deck as the vessel left the ways, so that no one was needed below at the time. One wheel did not turn at all, the other three made a limited number of revolutions, the ropes tore apart, and the wheels stopped with the ship. These three ropes and their weights ended the run in a highly disorganized state. They did very little damage, thanks to the wood guards placed around them. The intention was to leave the wheels free to revolve on the ways and lock them as soon as the vessel floated. As an indication of the stopping effect of fully locked wheels, as well as of their size, the calculations showed that they contributed just fifty per cent of the water resistance working to stop the vessel when afloat. It was no wonder that they were somewhat feared as possible premature stops, particularly as these large vessels are frequently launched without propellers in place.

Dredging the river bed to allow for the dip prior to pivoting was necessary to a limited extent only. The depth of the yard averages some forty feet at high water, except close inshore. Further off there was a bank which had to be cut through for safety. Allowance had to be made for a static dip of some thirty-five feet aft, with ways about three feet below keel. As it was quite possible to damage both ship and wheels by the ways fouling, a cut was dredged through this bank for the width of the ways. The builders were fortunate to be able to launch safely, after such a small amount of dredging.

The vessel was constructed under cover, except as to the two ends, which projected beyond the shed lines. The ground slope was at 0.5364 inch per foot, and the main weight-bearing area was supported by concrete piles, topped with concrete caps. The upper end was supported by steel girders carried on brick piers. The lower end was carried by wooden piles and caps, below high water.

The steel girders under the launchways were supported for the launch itself by bays of steel columns, heeled on special concrete foundations set in the ground. Keel blocks were set central and at a height of 5′ above and parallel to the ground slope.

The slope of the ground ways was 0.6364 inch to the foot, and straight from end to end—no camber. They were 7′ 6″ inches wide and heavily ribbanded on the outside. Solid blocking was fitted all fore and aft between ways and ground. They were centered 27′ 9″, the distance between ribbands being 35′ 3″, or just one-third of the beam.

The ways were specially built for this launch, and were 15½″ thick and of yellow pine, oak-faced only at the lower end for

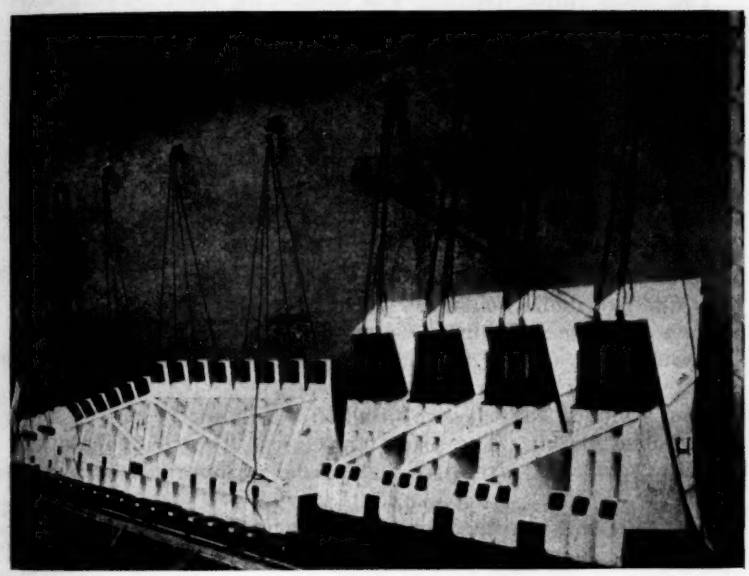

FIG. 1.—THE FORE POPPET, LAUNCH OF THE "SARATOGA"

pivoting. In order to get strength at the forward end to take thrust from the starting rams, if necessary, the forward section was built continuous for 300 feet on each side. This carried the solid ways well down beyond the open girders at the head on to solid ground.

The building and sinking of the outboard seventy-five feet were operations calling for considerable skill; the outer end was 6′ below low water and 12′ below high. The piles were cut off level and a tapered cribbing built with the ways in place, the whole being sunk over the bed of piles and secured by divers. Ways

were greased before sinking, and this grease was cleared by a diver before the launch of mud, rivets, bolts, washers, etc., and reported in good shape after some six months' submergence.

The sliding ways, like the ground ways, were new, built in 35-foot sections generally and 7′ 6″ wide, of yellow pine, oak-faced only under the forward section for pivoting. The thickness was 15½″.

The fore poppet, Fig. 1, was of the now fairly well-known New York Ship type of rocking poppet. As in the past, it functioned properly and the structure sustained no damage. The total pivoting pressure was 3,900 tons on an area of 450 square feet, half on each side.

The usual spruce packing was amidships, solid between ways and ship. Between solid packing and fore poppet, owing to fineness of lines, fourteen special vertical shores and saddle bands had to be fitted. Aft, the solid packing gave way to vertical shores as usual; these were close-spaced for the after poppet.

Owing to the overhang of the bilge amidships beyond the ways, a line of tumble shores was fitted under the docking keel on each side, thus supporting the bilges till they fell.

Internal shoring of wood bracing was fitted to back up the fore poppet.

In the double bottom amidships, steel shoring of 8-inch channels was fitted. Similar channel shoring was fitted over the double bottom where the machinery foundation girders were wide spaced. These channels carried the loads diagonally from the weak to the strong parts of the structure.

Long wooden shores were fitted in the motor rooms to stiffen the double bottom. The after poppet was located under a very strongly reinforced part of the ship, and no internal shoring was fitted.

The steel shoring amidships was depended on to prevent damage in the region of maximum way-end pressure; the usual wood shoring was not trusted.

The holding rams and triggers were of the now well-known type, used generally for large launches. There were four of these 14-inch rams, set in pairs under each ground way in a common trigger pit. Auxiliary rams were made for the purpose of forcing out the steel shores under the safety latches, allowing the same to be dropped just prior to release.

The available and test pressure was 4,000 pounds per square inch; 2,500 to 3,000 pounds was the maximum pressure in any way expected to be necessary, but even this was not needed. A pressure of 1,600 pounds held the ship, corresponding to a push of 480 tons along the line of ways, so the balance between weight, slope, lubricant and readiness to start was very good and in no way alarming.

The vessel started quietly and easily as soon as the pressure was released. In addition to the tumble shores aft, she had a line of these shores under each bilge. One keel block jammed and was left to be tumbled by the ship.

The starting rams were not needed. There were four rams at the head of the ways and three smaller rams on each side at intervals down the ways. At 3,000 pounds per square inch hydraulic pressure, a total force of 1,500 tons could have been exerted to start the ship.

It was decided, after considerable investigation, to trust to an anchor-stopping arrangement.

The bow anchors were placed three on the port bow and one on the starboard. This gave a perceptible slewing as well as stopping effect to the after pair of these port anchors. The anchors were all released on signal as the vessel left the ways by cutting manila lashings.

The two after-slewing anchors were in place before the launch and came into action after the ship was 200 feet clear of the ways. All anchors were of 20,000 pounds, navy stockless type.

The bow anchors all worked, though one of them did not break the manila stops placed to ease the shock. The stern anchor lines failed after 380 feet of travel along the river bottom. The ship traveled 985 feet after leaving the ways and slewed fifteen degrees.

The connecting shackles to the ship failed; the lines held; the anchors were very deeply bedded in the river bottom when the shackles let go. Examination later showed faulty metal in the shackles.

The actual speed figures are given in Table I.

TABLE I

Travel in feet.	Observed velocity in feet per second.	Calculated coefficient of friction and resistance.
25	6.5	0.012
50	9.6	.0095
100	14.4	.0075
200	21.2	.012
300	24.5	.034
400	25.0	.045
500	24.7	.0475
600	24.2	.049
700	23.6	.0495
800	23.0	.05
900	22.25	.0505
932	22.0	.051

The vessel left the ways at 932 feet of travel; no drags in effect as yet.

The initial coefficient of friction was 0.026, the final resistances against starting totalling about 670 tons, including tumble shores.

The Camden yard had been experimenting on "Paragon Launching Stearine" for some years, and it had behaved so well in ordinary launches that it was decided to use it for this launch. A thickness of ¾″ of "Paragon Launching Stearine" with ⅛″ of "Neptune Launching Grease" over, nominal thicknesses was used; the greasing irons were 1″.

The result was an unqualified success; under pivoting there was no smoking, the thickness left under pivoting pressure being a scant ½ inch after the vessel passed off. The mean temperature for a week before the launch was 50° F.; maximum 65° F., minimum 33° F. On the day of the launch, the average was 52° F.; at the actual time of launch it was 59° F. The total lubricant used was 68,400 pounds.

The absence of squeezing out was noticeable. The forepoppet rocker surfaces were coated with "Neptune" grease.

Calculations had been made for a maximum way-end pressure of 11 tons per square foot at 6 feet tide, or 11′ 10″ of water over way ends. The actual tide was short of the expected tide by 6″ and caused anxiety over the resulting pressure, which went up to 15.1 tons per square foot for 5′ 6″ tide and 11′ 4″ depth of water over way ends. The bottom stood up well. The following reasons are submitted for the successful withstanding of this abnormal pressure for a warship bottom:

(1) Longitudinal bulkhead over outboard edge of ways in the region of heavy pressure.

(2) Electric welding in way of ordinary double bottom longitudinal relieving rivets.

(3) Steel shoring instead of wood in double bottom.

(4) Heavy machinery foundation girders reinforcing double bottom.

(5) Flanged lightening holes in transverse floors, instead of the usual hole and flat floor.

As is generally known, battleship bottoms have shown signs of failure at ten tons and less per square foot way-end pressure.

The standard frame spacing for such ships is four feet, and the *Saratoga* has this spacing. Very careful examination after the launch showed everything in order and no damage.

Clearing away blocks and shores followed the usual procedure. The ship crept down hill less than ½ inch as the blocks, etc., were removed. The precautionary dogshores fell easily and left her on the triggers. On release of these, she started very deliberately owing to the large number (forty-seven) of tumble shores and one jammed keel block. About 20 seconds elapsed between the release of hydraulic pressure and clearly perceptible motion. The

tumble shores had relatively small corner radii and offered a good resistance to an abrupt start. Sights taken along the line of ways showed no local settlements as the blocks, etc., were removed.

Besides the anchors, there was a slight drain of tide still going upstream to help the slew; the outboard port propeller was fixed throughout. A 12-mile breeze acted at 45 degrees on the starboard quarter, also sending her upstream.

A fleet of twelve tugs, three of which were powerful ocean-going tugs, berthed the ship safely.

The general data is conveniently summarized in Table II.

TABLE II

Dimensions of vessel	888′×106′×74′
Date of launch	7 April, 1925
Time of launch	1:15 P.M.
Place of launch	Camden, N. J.
Weight of ship, etc., tons	24,630
Weight of cradle, tons	1,100
Total launching weight, tons	25,730
Length of ground ways	932′
Length of sliding ways	712′
Declivity of keel and ways, per foot	0.5364″
Bearing area, square feet	10,500
Initial mean pressure, tons per square foot	2.45
Width of ways	7′ 6″
Spread of ways, centers	27′ 9″
Water over way ends at launch	11′ 4″
Static drop of ship	5′
Mean draught afloat, F. W.	18′ 9″
Maximum way-end pressure, per square foot	15.1 tons
Minimum moment against tipping, foot-tons	305,000
Pivoting pressure, tons	3,900
Height of tide, actual	5′ 6″
Height of tide, expected	6′
Maximum speed, feet per second	25
Drop off speed, feet per second	22
Travel after drop off, feet	985
Angle of slew, degrees	15

American Armaments

From the Japanese Press, Osaka *Mainichi*.—It is announced from the United States that an agent of President Coolidge issued a statement with his authorization that the United States would not in any manner whatever participate in arms competition. The statement says further that the United States would reserve to herself the right to make proper provisions for her defense, irrespective of what policies other nations may adopt, but that she had no intention of competing with others in the expansion of auxiliary ships and air forces.

No one in the world questions the good faith of President Coolidge in the cause of international peace, that he hopes for the reduction of military expenditures and is extremely averse to arms competition. We are firmly convinced that the statement conveys his truthfulness and fidelity. His agent ventures to testify that this statement of his is most significant and comprehensive in scale, but it is doubtful whether his sincerity will follow his principles. The statement is said to have been issued to define the fundamental principle of the Republican Government in contrast to the ambitious but risky manifestation of Mr. Wilbur, Secretary of the American Navy, that the United States would hold a scepter over the world immediately she had completed her air corps. Who will assert that Mr. Wilbur is the only advocate of militarism and that no other American statesman will succeed to his principle?

President Coolidge energetically restrained the American defense system from being expanded till the Morrow Commission was organized, but the report prepared by that commission established the policy of the United States' defense. Its force overpowered the Republican head. Auxiliary cruisers were constructed, a base of operations for the United States Navy in Hawaii was strengthened, and also comprehensive plans for the expansion of the United States Navy and Army were worked out.

The United States Congress is supreme in matters of military defense. Its authority in this line is absolute. Neither the power of the President nor the original plan drafted by the War and Navy authorities has influence over Congress. The War and Navy Committees in the American House of Representatives are despots, others being overruled. Mr. Butler, the chairman of the Navy Committee in the Lower House, boldly stated that, in the event that the Geneva and other international conferences should be unsuccessful in the limitation of auxiliary ships the United States would perhaps pass a resolution for the expansion of her defense system on the most comprehensive plan imaginable. What a bold statement! He wants to coerce others into obeying the injunction of the almighty United States and to effect a satisfactory limitation of auxiliary ships.

It is an open secret that the United States is averse to the limitation parley at Geneva, and that it is her ambition to hold an arms conferences upon auxiliary ship limitation in Washington independently of the Geneva Assembly. The United States has a free hand to break down the unity at Geneva. In opposition to the French proposal in respect to the limitation of auxiliary ships, American insistence upon the maintenance of the 5-5-3 ratio is tenacious and obstinate. American obstinacy and stubbornness will break down the unity.

It is the deadly ambition of the United States to maintain the ratio of 5-5-3 or to find an adequate pretext for the expansion of her Navy on a comprehensive plan. How far should we rely on the good faith and power of President Coolidge? And how far must we suspect the ambition of the American Congress?

Naval Rights

Naval and Military Record, 8 September.—The recent case in which the commanding officer of the United States destroyer *Lardner* declined to deliver to the British police a seaman who is alleged to have attacked a Phillipino shipmate on shore at Gravesend appears to have interested the lawyers very much more than anybody else. The sailor escaped back to his ship, lying off Northfleet, after shooting the colored man, and when the police requested his surrender the commanding officer declined to give him up, as being on board an American warship he was practically on American soil. Incidentally that particular bit of American soil was in British territorial waters at the time, and the fact that any of her people should have landed with firearms was a direct violation of international law. Most commanding officers, we fancy, would have been glad enough to hand over a job of this sort to the civil authorities, and so save themselves any further trouble.

The fact is the law is not very clear upon the question, and the commanding officer of the *Lardner* was depending more upon usage than anything else. Hall, in his *International Law,* says that a vessel of war in foreign waters is regarded "by a great preponderance of authority" as not subject to territorial jurisdiction, and that the surrender of a refugee on board of her must be obtained diplomatically. The United States did not consider this principle in the days when one of the federal cruisers seized Slidell and Mason from under the British flag, thereby bringing an ultimatum from Lord Palmerston. The course taken by the commanding officer of the *Lardner* was justified, but unusual. It can only result in giving the civil authorities a great deal of trouble to attain what the law of the land requires. There are a good many things which the commander of a warship may do which in point of fact he never would do.

An interesting point in international law was mentioned at the inquest at Gravesend on Thursday on Emild Parad, a member of the crew of the United States destroyer *Sharkey,* who was shot outside a dance hall last week.

A colored sailor from another American destroyer, believed to be concerned in the affray, is stated to have been placed under arrest by the captain, who refused to give him up.

The coroner announced that should the jury return a verdict of murder or manslaughter, it was his intention to issue a warrant for the arrest and prosecution of the man concerned, who had since sailed on the destroyer,

the captain declining to give up the man, claiming that the ship to which the man returned was American territory, over which this country had no jurisdiction.

GREAT BRITAIN

German Vessels' Gunnery Superior to that of British.

Hector Bywater, Baltimore *Sun*, September 19, London, Sept. 18. (Special Cable).—That Jutland, although not a German triumph was "a success on points for German arms," is the candid verdict recorded by H. W. Wilson, British naval historian, in his book *Battleships in Action* which will be published here Monday.

Because this book represents the first attempt to give an impartial, objective history of the late naval war, its version of the Jutland battle differs on many important points from the official British and German histories, which either suppress or gloss over awkward facts.

Wilson writes frankly of British defects in ship construction, gunnery, shells, and other equipment. He shows by authoritative figures that in most naval actions of the war the German gunnery was superior to the British.

Germans Find Target Quickly.

Whenever the Germans opened fire they almost always began hitting at the third salvo, while the British took much longer to find the target. A deadly feature of the German fire was its astonishing rapidity. In the Coronel battle von Spee's ships fired three shots to one by the British.

At Jutland the speed of the German firing was equally as remarkable. The British battle cruiser *Indefatigable* was sunk by von de Tann in a duel in which the German vessel wasn't hit once. During the first hour of the fighting the German squadron scored twenty heavy hits, the British, four.

The "Queen Mary's" Fate

The fallacy of the official theory that the *Queen Mary* and other British ships were destroyed with lucky hits is exposed in data now revealed. The *Queen Mary* literally was smothered with shells, of which fifteen to twenty struck her at once, and as every German shell pierced her armor and burst in the hull with tremendous force the ship quickly was blown up.

On the other hand, not only was the British cannonade slower and less accurate but the projectiles often broke up on impact or detonated feebly.

The British were further handicapped by inadequate protection of their ships. Although the Admiralty had had ample warning, anti-flash precautions were neglected and fearful loss was suffered because of this and powder fires.

How Beatty's Ship Suffered

The battleship *Malaya's* entire starboard battery was wiped out with two shells, which ignited powder bags and killed or wounded one hundred men.

Toward the end of the fight Beatty's flagship, the *Lion,* was in a lamentable state, her decks "knee-deep" in water, so that the wounded ran a risk of being drowned as they lay.

"Everywhere in the ship were fires; dense, choking smoke, steel splinters and torn plates with edges that cut like razors."

Throughout the battle Beatty and his staff remained on the upper bridge recklessly exposed to the tempest of shells and splinters, but escaped injury.

British Losses Heavy

The British Jutland casualties number 6,784, being 11 per cent of the total personnel engaged. The German losses were 3,058 being 6.8 per cent.

In no other battle in history had the British Navy lost so heavily. All this was the work of the German gunners, since no British ship succumbed to torpedo attack.

Stress is laid on the virtual unsinkability of the German ships. They survived tremendous pounding—even the small cruisers were hard to sink.

Wilson condemns Jellicoe's handling of the grand fleet as too cautious, blaming him for the indecisive result of the action. He contends the British fleet should have closed with the enemy even after nightfall, as, with its enormous superiority, it could have afforded to take risks.

Beatty's tactics are praised as excellent throughout.

Inefficiency Found

Other revelations concern the inefficiency of the British torpedoes, which were short ranged and often erratic in running. The British submarines had torpedo tubes set at an angle, which made accurate shooting difficult. Instability of ammunition is blamed for the mysterious blowing up of several British ships in the harbor, including the battleship *Bulwark.*

After Jutland, many improvements were introduced in ships' armor, shells, torpedoes, etc., but it was then too late, for no second battle took place.

Wilson speaks highly of the American naval support to the Allies, but regrets that the United States delayed so long in developing a powerful naval force in the war zone.

Aircraft Carriers in a Fleet Action

Journal of the Royal United Service Institute, Aug. 1926.—The addition to the fleet of a new type of warship, the aircraft carrier,

has opened up a fresh problem in fleet tactics; in view of the very important duties aircraft may perform during an action and the limited number of carriers as yet at the disposal of the commander-in-chief, considerations for these ships safety must have an important bearing on the conduct of a battle.

Broadly speaking the loss of the aircraft themselves of comparatively small importance, but the loss of a carrier is a serious matter. If the output of airplanes is up to war standards, it should be possible to replace any that are lost without undue delay, but the replacement of a carrier is a very different question. Apart from the length of time it takes to build or convert a ship suitable for launching and landing fleet aircraft, shipbuilding in war time will have calls of all natures and, if the conditions of the late war recur, even the construction of carriers may have to take second place to destroyers and other small craft necessary for the multifarious duties connected with the protection of shipping.

The commander-in-chief must, therefore, continually bear in mind that while his carriers are indispensable to the fleet they are also extremely vulnerable and cannot easily be replaced. At first glance the problem of protecting them would seem simple enough. Carriers are designed to have a high rate of speed,[1] and if they can attain some ten knots in excess of the speed of the battle-line there would appear, at first sight, to be no difficulty in keeping them in a position of safety relative to the enemy fleet. But it must be remembered that the enemy destroyers and cruisers will have a speed at least equal to our carriers, while the latter will not always be free to use their speed for the sole purpose of seeking the cover of the battle fleet.

In order to fly machines off and on, a definite wind speed over the deck is required. To obtain this in a flat calm it is only necessary for the carrier to steam at a sufficiently high rate of speed. Under these conditions her course can be entirely governed by the tactical situation and she will have little difficulty in remaining in a position of safety. Her speed will be adequate for avoiding attack by enemy craft of all types and her maneuver will not seriously interrupt the flying service.

If there is any appreciable wind, however, her movements are likely to be considerable restricted, for, to perform the operations of flying off and on, she must steam either directly into or directly away from the wind. The latter, of course, can only be done with a very low wind force and by a carrier with a high speed, because the speed of the ship through the air must be such as will overcome the velocity of the following wind and, in addition, produce a wind speed over the deck sufficient for the flying service.

[1] This is not so at present with all, but future construction will undoubtedly be given the maximum speed possible.

In most cases the weather conditions will be such that no planes can be despatched or received excepting with the carrier steaming head to wind, when the maintenance of her position relative to the battle fleet will be further handicapped by the fact that her speed must be varied according to the wind velocity at the moment of any particular flying operation. Thus it will become a difficult matter to forecast her position at any particular moment.

The operations of flying off and flying on must be considered separately. In flying off, the time during which the carrier is required to steam into the wind is small. The aircraft to be launched can all be ranged on the flying deck, or decks, previous to turning head to wind, and as soon as the ship is ready the machines are flown off in rapid succession.

Let it be assumed that the wind is from right astern of the fleet. It will take the carrier some five minutes to turn 180 degrees. It is then necessary for her to steam at 20 knots for, say, three minutes head to wind while flying off a flight of machines. She then turns again to regain station. In all, thirteen minutes has elapsed, during which time the fleet (at 20 knots) has proceeded 4.3 miles and the carrier has steamed one mile on the opposite course. To regain station the carrier has to make good 5.3 miles. Assuming she is able to develop a relative speed of 10 knots, this will take thirty-two minutes.

In the above case it was assumed that the wind was in the worst direction relative to the course of the fleet. Let us suppose, however, that the carrier was originally stationed well up with the advance forces. After her initial flying off she has dropped back to some position near the battle fleet. If the commander-in-chief now requires more aircraft from this same carrier, he must either wait until she has regained her station, accept another drop in her position, which will probably place her astern of the fleet and open to attack from enemy cruisers or destroyers disposed astern, or he must effect some drastic reduction in the fleet's speed.

Now let us assume that the wind is at right angles to the line of advance of the fleet. Allow two minutes for the turn into the wind, three minutes either out from or in towards the line of advance, and then three minutes for the turn back on to the course to regain station. The distance now to be made good is just under three miles at a 10 knots relative speed. So it is seen that, even in this case eighteen minutes at high speed must elapse before the carrier is once more in station. She has, however, only dropped back roughly two and three-quarter miles from her original position, and she would have time to carry out another similar operation before falling astern of the fleet's protection.

Flying on presents a far greater loss in position under the conditions considered above. The time taken to fly on will vary

according to the type of carrier and the facilities available for restowing machines. As a general rule, the landing deck must be cleared before the arrival of each successive machine. These intervals will necessitate the carrier maintaining her course for some eighteen minutes as against the three required for flying off. The drop in position under adverse wind direction is correspondingly very much greater and the maintenance of the carrier in a position of safety becomes doubtful.

The safety of carriers with the fleet depends on two things—their powers of self-protection, i.e., speed and armament, and their position relative to the battle fleet, in action. With regard to the first, speed and armament are, of course, a question of design. The ship herself is very vulnerable in that the hull presents a big target and the large stores of petrol, including that standing the aircraft make her more than ordinarily inflammable. Added to this very little damage is necessary to the flying deck to make it useless to aircraft. As regards armament it is not possible to carry anything more powerful than that of a cruiser. Designs have been suggested for a combined battleship and aircraft carrier, but such a type is not likely to materialize, for the result would be useful neither as the one nor the other. As a battleship, this hybrid would be unable to take her place in the battle-line owing to the necessity of flying off and on. As a carrier she would be hampered by the space occupied by turrets and, if attempts were made to fight her guns when she was working aircraft, the latter would be considerably disturbed by blast. Moreover, as speed is essential to the ship in her capacity as carrier, it seems extremely doubtful whether all these requirements could be combined in a ship conforming to the Washington Treaty.

It is far more probable that development will be along the lines of high speed and improved facilities for handling aircraft, while the armament will be no more than one which will enable the ship to defend herself to some extent against small cruisers and destroyers.

Turning to the question of the position of carriers in the fleet while in cruising and battle order, we see that there can be no set position and every operation has to be considered separately; first in the light of the probable force and direction of the wind; second, from the point of view of the probable course of the fleet in cruising disposition, its direction of deployment and subsequent probable movements; last, with regard to the position and course of the enemy.

In studying the problem it must be borne in mind that the functions of a carrier are, broadly speaking, two-fold. She has to provide aircraft for reconnaissance during the approach and, subsequently, for observation of fire and for reporting movements of the enemy; she has also to be ready to launch torpedo and

fighter airplanes. Of these two, the former duties are the most important because the fighting power of the whole fleet may be dependent on airplane observation whereas the second are, as yet, only auxiliary forms of attack and defense. So great has become the value and importance of aircraft reporting that in the near future, under favorable weather conditions, we may find it superseding the cruiser screen. Should this become possible, it will enable the cruisers to be concentrated before actual contact with the enemy, instead of keeping them spread until the last moment.

To maintain a continual supply of reconnaissance machines will necessitate very close cooperation between the carriers themselves. In fact a squadron of carriers is really a most important command. Each ship will probably have to fly off and on at least every two hours. It is essential, therefore, that the carriers should be so stationed relative to the main fleet that they will not drop astern of the battle fleet during the approach. They must also be clear of the line of advance so that their movements are not likely to hamper the course of the main fleet. This is the more important as the time of deployment draws near. If sufficient information is available they can be stationed so as to ensure that the enemy light forces will not at the outset make contact with them. The strategical plot, therefore, becomes of great importance and the carrier squadron must amend its position as the plot progresses so as to ensure that they do not come under fire of the enemy's main forces. It must be borne in mind that the carriers may get out of direct touch with the commander-in-chief, in which case they must take such action as appears necessary to remain in or regain safety without awaiting instructions. Finally, they must anticipate the direction of deployment of the battle fleet from their own strategical plot. It may be possible for the commander-in-chief to inform his advance forces of his intentions, but that this information will penetrate to all carriers cannot be relied upon.

It is essential that the carriers should not be left "in the air" after deployment and they must leave no doubt in the mind of the commander-in-chief that they are proceeding to their battle position in plenty of time before deployment.

It may be the enemy's intention to allocate a portion of his light forces for the express purpose of attacking our carriers. In this case the latter must rely on units of their own fleet for protection and, abandoning flying for the time being, retreat under the protection of these protective forces.

In the case of the wind being in an adverse direction, an initial position on the disengaged beam of the battle cruisers appears best. Here the carriers will be covered from attack by enemy craft crossing ahead of the battle-line and they can best afford to lose distance during their flying operations. The distance away from the line of advance of the battle-line is governed by the amount

the carriers will increase or decrease this distance while operating, the limitation being, of course, that such operation must not bring her within gun range of the enemy fleet. At the same time they must keep sufficiently in touch with their own fleet to observe its movements and to be able to conform to them as soon as they are free to do so.

In the event of the commander-in-chief reversing the course of the fleet during the engagement, in view of a similar movement on the part of the enemy or massed torpedo attacks, it will probably be necessary to cease operating aircraft until a position of comparative security is again attained by the carriers. This possible fleet movement would be an argument in favor of stationing the carriers initially further back from the battle cruisers and nearer the battle fleet and, consequently, accepting the resultant shorter distance available for loss in operating aircraft under adverse wind conditions.

Generally speaking it must be the object of the commander-in-chief to save his carriers from contact with enemy forces by countering enemy movements against them; on the carriers' part it is is their duty to ensure that the commander-in-chief's anxiety shall be a minimum.

It is difficult to lay down whether flying or the safety of the carriers themselves should be the first consideration. It has been seen that it will take considerably longer to fly the same number of machines *on* than to fly them off. Of these two operations flying off is the more important and, in regard to types of machines the provision of reconnaissance and spotting airplanes should come first. Nevertheless, there is the psychological moment at which the torpedo planes should be launched to the assault. They should be timed to attack in conjunction with the destroyer forces and when the enemy battle-line is fully engaged. This will have the maximum effect in dislocating the enemy's line, and throwing out his gunfire. Once a carrier is committed to launching her torpedo planes the flying off of accompanying fighter machines will not add greatly to the loss in distance.

The return of these machines is another matter. The attack completed, the craft will probably return at a time when the carrier is still endeavoring to regain her position in preparation for flying off a relief supply of reconnaissance machines and landing on other similar machines for refueling. Again the reconnaissance service is of the first importance and it seems that the returning attack machines must take their chance. It may be possible to land on at the same time as the more important reconnaissance machines, but it seems likely that, under certain conditions, they must be sacrificed in order that the carrier may maintain her position.

Throughout the foregoing no consideration has been taken of the probable attacks on the carriers by enemy aircraft. This further complicates matters. While flying off or on, a carrier presents a steady target. During these operations indiscriminate anti-aircraft firing is impossible and the carriers' primary defense must be aircraft. Allowance has, therefore, to be made in her movements to ensure a supply of machines for defense purposes. Probably the best method of defense would be the harrying of the enemy's carriers with aircraft. The enemy, however, may concentrate on the destruction of reconnaissance and spotting machines, in which case fighters must be maintained in the air for their protection.

The whole matter becomes more involved the deeper it is probed. Over and above all is the question of the safety of the carriers themselves. That is of primary importance, at least until such time as the defeat of the enemy is assured. As long as there is a likelihood of further operations at sea the safety of the carriers must remain a most important matter to the fleet.

The answer to these problems can only be obtained by constant trials and exercises in peace time. Unfortunately there are matters which greatly hamper the attainment of satisfactory results. Economy reigns supreme and the limited supply of fuel prevents the carrying out of fleet exercises at high speed; besides which, the life of a warship is short and wear and tear of machinery must be considered. Finally, it is not possible to assess the effectiveness of anti-aircraft measures. Up to date there are no data on which to base an estimate of casualties and it is very difficult to say what proportion of aircraft are likely to return on completion of their duties, thus making it difficult for the carrier to make allowances of time for flying under war conditions.

Fleet exercises take place at a proportionally reduced speed. This works satisfactorily until the matter of carriers is considered. They must steam at high speeds to work their aircraft, and as soon as these speeds are employed sense of proportion is lost. A carrier may steam 30 knots down the battle-line while landing on, but if the fleet is moving at 10 knots instead of twenty, she is afforded protection for a proportionately longer period than would be the case in war. In another case, light craft, limited to 17 knots, are in pursuit. The wind is favorable and the carrier employs her full speed away from the enemy while flying off and on. Thus in these peace practices the range is being opened, whereas under war conditions the enemy could keep it more or less constant. It is essential that this lack of reality be remembered or false impressions will be created.

The whole subject is one requiring much investigation and, up to date, it can safely be said that only a beginning has been made in this phase of fleet tactics.

The Value of Malta.

Naval and Military Record, 26 Aug.—The recent comments in this journal upon the subject of the alleged Italian view with regard to Malta have attracted attention in Italian naval circles, and are regarded with much favor. We would point out, however, that these comments were simply based upon the discussion to which the Malta *Daily Chronicle* devoted considerable space, and that any suggestion of "unfriendly sentiments" is rather misdirected. In view of the particularly cordial relations which exist between the British Navy and the Italian Navy, it would be merely ridiculous to imply insincerity to this traditional friendship. But the point in question really embraces a most interesting strategical consideration, and one which, according to the Malta *Daily Chronicle,* is engaging Italian thought very much more than British thought. The balance of naval power in the Mediterranean has changed considerably since the war. Italy has wider aspirations than at any period in her modern history. France, on the other hand, appears to be satisfied with a relatively inferior status in comparison with her pre-war standard. Spain is a growing factor in the situation. Austria, as a sea power, has disappeared.

Naval expansion cannot be limited to fleets alone. It must envisage all the strategical conditions which make for the most effective employment of fleets, and in this category the question of bases is predominant. Thus we find that since the United States constructed the Panama Canal she takes quite a different view of the British possession of so many of the islands of the West Indies, and more than once it has been pretty plainly hinted that she would wipe out our war debt to her—and possibly add a bit as well—in exchange for Bermuda. There is nothing friendly about this point of view. It merely shows strategical perception. One of the strongest arguments advanced against granting autonomy to Ireland was that if we relaxed our sovereignty the country might some day furnish war bases to a hostile power. We should not much relish the establishment of an American naval base at Berehaven, for instance. By realizing this it becomes easy to understand the American point of view with regard to Bermuda.

It is quite intelligible that Italian strategical students should contemplate Malta in much the same frame of mind. The Island is the key position to any scheme of supremacy of the Mediterranean. Napoleon clearly realized this when he ordered that Malta was to be retaken at any cost; so did we when we made it clear that at no cost should it be retaken. By holding Gibraltar we command the Atlantic exit from the Middle Sea; by the retention of our protectorate rights over the terrain through which the Suez Canal is cut we command the Eastern exit. But these focal points do

not command the Mediterranean, which is a veritable ocean in itself. Turkey, Greece, Italy, France, Spain, Morocco, and Algiers could fight a great sea war without any reference to Gibraltar or Suez. But Malta is a strategical hub. A fleet based upon it could operate in any part of the Mediterranean zone, and could dispute the passage of any force which aerial observation might report to be approaching.

Italy has always appreciated the strategical value of Malta, but down to the time of the Great War her naval preoccupation was confined to the Adriatic. Freed from this objective, and taking a much more spacious view of sea power, it is only natural that her realization of the value of Malta should be much accentuated. The spirit of Imperialism which Signor Mussolini is so patriotically fostering lends a deeper meaning to her interest in Malta. But we do not appreehend the existence of any menace that this question will ever develop beyond its sentimental aspect. Italy would very much like to possess Malta and feels that, in ethnological fitness, she should possess Malta. But Great Britain is firmly established in Malta, and the most powerful single fleet in the world is based upon the Grand Harbor. We are never going out voluntarily, and the task of turning us out, and keeping us out, is not one which even the most fervent political aspirations could contemplate as a feasible adventure. Malta in British hands is no threat to anybody; Malta in other hands might be a very serious threat to British commerce. Italian statesmen realize this clearly enough, and are under no illusions upon the subject. The *vox populi,* raised without any very definite understanding of the reasons why we intend to stick to Malta, may occasionally take on a "stunt" note, but it raises nothing more than a hollow echo.

Submarines and Safety.

Naval and Military Record, 26 Aug.—The tragic mishap to submarine *H-29,* within the placid waters of her own haven, would have called forth a great outburst of moralizing in the early days of the submersible boat. Nowadays it is regarded as one of those periodical calamities which are an ever-present menace of the type. It is true to say that the risk of disaster in a submarine has been brought down to the irreducible minimum. But that irreducible minimum must inevitably stand fixed at a considerably higher point than in any surface vessel. Public opinion has now come to quite realize this fact, hence we hear comparatively little of the "death-trap" order of comment following upon any calamity. The service itself has never been under any illusions upon the matter. It clearly apprises the obvious risks, and the mysterious, or indeterminable risks, of the submarine. If it finds any source for wonderment on the subject at all it is that so few mishaps

occur. When one considers the number of submarines in existence in the navies of the world, daily coming and going in the pursuit of their normal routine, the proportion of serious accidents is infinitely small.

But what we do hear following upon each fresh submarine disaster is a whole crop of suggestions for the prevention of such disaster. Most of these suggestions are pretty old friends—quite stereotyped, indeed. The subject is one to challenge ideas, and the originators of these ideas take every fresh opportunity of again putting them forward, with the implication that had the particular suggestion in question only been adopted by the Admiralty many precious lives would have been spared. Any inference of neglect or indifference on the part of the Admiralty in this direction is merely ridiculous. Every suggestion put forward is carefully considered. The great bulk of the ideas follow certain more or less obvious lines, and in one shape or another have either been adopted or rejected years ago.

The originators of these suggestions for ensuring safety in submarines are almost invariably amateurs, with no technical knowledge of service in submarines. It needs no technical knowledge to evolve an idea which is theoretically excellent; it does need technical knowledge to understand why it is not practicable in practice. The one condition which few of these inventors appear to understand is that a submarine disaster is terribly swift, and that the inrush of water gives the inmates no opportunity for taking advantage of the elaborate and ingenious arrangements which they propose. The safety helmet and the air lock remain the principal means of escape from a sunken submarine, but experience has taught that in most cases of disaster men are drowned before they can reach these against the rushing torrent which pours into the hull.

Battleship Reconstruction.

Army, Navy, and Air Force Gazette, 11 Sept.—It is natural that a contrast should be drawn between the fate which is overtaking the older battleships in the British and United States Navies. Whereas the *Ajax, King George V* and *Thunderer,* completed in 1912-13, are in the process of being scrapped, and their sistership, the *Centurion,* converted into a target ship, the six vessels of the *Florida, Arkansas* and *Texas* types in the American Navy, four of which may be said to be contemporary with the British ships and the other two of an even older type, are in the process of being modernized to render them more fit for further service. In either case the procedure is in accordance with the Washington Treaty, and there is, or should be, no cause for surprise. The British vessels are going out of service to make way for the *Nelson*

and *Rodney,* nearing completion. To retain them would be to increase the British ratio beyond the 5-5-3 as against the United States and Japan which the Conference of 1921-22 laid down as the basis to be adhered to. No nation has gone further in applying the terms of the Washington pact than this country, and it is quite in keeping with our policy that the *Ajax* and her contemporaries should have been paid off several months before the new battleships are likely to be in service.

The question has been raised as to what extent the American battleships are to be modernized. Obviously, such a term is capable of widely differing interpretations. But in this instance the nature of the work which can be done is clearly defined in the replacement clauses of the treaty itself. No retained capital ships may be reconstructed except for the purpose of providing means of defense against air and submarine attack. For this purpose the contracting powers may equip the vessels with bulges or blisters, or anti-aircraft deck protection, provided that the increase of displacement thereby does not exceed 3,000 tons for each ship. No alterations in side armor, or in the caliber, number, or general type of mounting of the guns in the main armament, are permitted, except in certain specified instances in the navies of France and Italy, and the armored protection of the British battle cruiser *Renown,* alterations to which had been begun before the conference assembled.

So far as is known, France and Italy, which were given the option of increasing, within the limits allowed for bulging, the armor protection and the caliber of guns in their existing capital ships, not beyond 16 inch, have never availed themselves of this right. America, on the other hand, has sought to bring her older ships as up to date as possible. Very soon after the treaty was signed, before, in fact, it was ratified on Aug. 17, 1923, it was proposed to increase the elevation and thereby the range of the guns of these older ships. The British Government, through its Ambassador at Washington, represented in March, 1923, that in its view the proposed alterations were not allowable under the terms of the treaty. The proviso that not alterations in the caliber, number, or general type of mounting of the guns are permitted surely rules out an increase of range, since it is impossible to see how a battleship's guns can be given increased elevation without altering their type of mounting. The American Government, while holding that, from a strictly legal standpoint, the work involved could not be regarded as reconstruction, expressed the opinion that it would be very unwise to take such action at the time, as it would tend to revive naval competition and could not fail to have a prejudicial effect on the prospects of another conference for naval disarmament. The same outlook, we may be

sure, governs this policy now in respect of the ships coming in for overhaul.

FRANCE

French Naval Progress.

Engineer, 10 Sept.—Without haste, yet without pause, the process of rebuilding the French Navy goes steadily forward. Not for a generation past has French shipbuilding policy proceeded on such definite and consistent lines. The practice of constructing experimental ships, each differing more or less radically from the other, which gave France a naval force not inaptly described as *une flotte des échantillons,* has been discarded. Instead, we are witnessing today the multiplication of vessels standardized in large groups according to type. More remarkable still, in view of former policy, is the laying down year after year of the quota of tonnage provided for by a long-term program of construction. Paper shipbuilding projects designed to satisfy requirements for many years in advance are no novelty in France, but they have hitherto suffered mutilation with every change of government. The Navy Law of April, 1922, differs from its predecessors in having been almost punctiliously adhered to for five years. Cabinets have come and gone, but the septennial program survives, and there now seems every probability of its being completed to the last unit. Thanks to this uninterrupted flow of new tonnage, the French Navy is rapidly regaining its former position as a weighty factor in the balance of power at sea. So far as capital ships are concerned, it is, of course, restricted to a standard of strength which patriotic Frenchmen declare, and not without reason, to have been fixed without reference to the naval traditions and actual maritime responsibilities of their country. Nevertheless, their protests are somewhat vitiated by the fact that French professional opinion no longer accepts the capital ship as the supreme instrument of naval power. In this case, doctrine so far governs policy that no vessel heavier than a cruiser has been laid down since the war, nor have any steps been taken to replace the battleship France, which was wrecked in 1922, though the Washington Treaty expressly authorizes the replacement of ships lost through accident.

To the building of vessels other than battleships and aircraft carriers the treaty sets no limit. In the construction of cruisers, torpedo craft, and submarines, the signatory powers are left with a free hand, and it is upon such light material that the French conception of naval strategy is based. The Navy Law of 1922, which has been amended only in minor details, provides for a total of 145 combatant ships. The fact that more than half of these are submarines attests the confidence of French experts in the power of the submarine arm. Flotilla leaders and destroyers to

the number of fifty-seven are included, the balance of the program comprising nine cruisers, a cruiser-minelayer, a training cruiser and two aircraft carriers. Clearly, therefore, the *guerre d' escadre* has little part in French naval calculations, in which the defense of the Mediterranean routes is the cardinal factor. Ignoring three old *Dantons*, which are admittedly kept on the active list as a counterpoise to the German pre-Dreadnoughts, the present French fleet musters only six battleships, all of pre-war design. Three are armed with 12 inch and three with 13.4 inch guns. As they have all been extensively reconstructed, it would appear that the capital ship still has some partisans in France, even if their influence is not sufficiently strong to secure reinforcements for the battle squadron. The value of the nine cruisers included in the program has excited much controversy, some critics condemning them as superfluous. In the report on the 1922 Navy Bill submitted to the French Senate, their functions were defined as follows: "(1) To protect destroyers and torpedo boats against the intervention of enemy scouting ships; (2) to clear the sea of enemy destroyers and torpedo boats; (3) to ensure regular intercourse with the French colonies." We are tempted to remark that, by substituting "cruisers" for "destroyers and torpedo boats" in the foregoing definition, an equally strong case might be made out for the building of capital ships. Cruisers can neither afford protection to their own mosquito flotilla nor maintain communication with oversea territories unless they are themselves protected from the interference of enemy ships of greater power, and such protection can only be given by capital ships. That, however is by the way. In a recent edition of *Brassey's Annual,* Captain Delpierre, of the French Navy, strongly opposed the building of cruisers, arguing that they were useless as a defense for troop convoys and were not required as scouts for a battle squadron, which in a few years will be virtually non-existent. "France," he concluded, "will regain her rank among the naval nations of the world only when she has succeeded in building powerful submarine and aerial fleets. It is only then that she will be in a position to defend herself, for she has never dreamed, and will never dream, of being the aggressor. Logically, there is no room in such a program for light cruisers." The fact remains that three cruisers of 8000 tons and six of 10,000 tons are to be completed by 1931, and it is not difficult to imagine circumstances in which these vessels would be of great value, though not, perhaps, in a campaign confined to the Mediterranean area. In developing the new torpedo flotillas, France has avoided her former mistake of building craft which were only formidable in smooth water. Diminutive "torpilleurs" have given place to large vessels of robust construction, high freeboard, and ample engine power. The first six flotilla leaders to be put in hand—*Chacal* class—displace 2400

tons; in the next three ships, now on the stocks, the displacement has been increased to 2700 tons, and the further units to be laid down this year will be of 3100 tons. Such vessels should be able to cruise and fight in weather which no ordinary destroyer could face, and their armament of five or six 5.1 inch guns of the latest high-velocity mark would render them dangerous antagonists, even for a small cruiser. France will eventually have twenty-one of these powerful craft, which in spite of their high cost are regarded as the most valuable surface ships of the new navy. The destroyers also, of which thirty-six are to be built, are large weatherly vessels of 1500 tons, mounting four 5.1 inch guns. The new submarine fleet, consisting of seventy-five boats, is divided into five classes, viz., submarine cruisers, large ocean-going boats, medium ocean-going boats, coast defense boats, and minelayers. The first of the submarine cruisers is to be laid down this autumn, the surface displacement being given variously as 3000 and 3500 tons. In either case the vessel will be larger than the British *X-1* and will probably surpass even the latest American *V* boats. The utility of such heavy submarines is as yet entirely speculative. In this country no attempt has been made to repeat the *X-1*, which seems to be something of a white elephant, and in deciding to build a submarine of unexampled tonnage the French Government has probably deferred to public rather than to naval opinion. The large ocean-going boats are of 1500 tons, the next class being 400 tons lighter, the two groups numbering collectively thirty-six units. The thirty-one coastal submarines contemplated are apparently of uniform design, with a displacement of 600 tons. Six mine-laying boats, details of which are not yet to hand, complete the imposing list of underwater craft. All these new submarines have been designed on the basis of war experience, and after a careful inspection of the surrendered German boats. While it is not to be supposed that French constructors, whose skill and ingenuity are proverbial, have been content to copy slavishly any foreign model, there is little doubt that certain meritorious features of German construction have been embodied. Special importance is attached to motor reliability, and judging from the prolonged endurance cruises already made by some of the new boats, French post-war submarines are equipped with thoroughly reliable engines. Their offensive powers have been increased by the adoption of the 21.7 inch torpedo, a more formidable weapon than the standard torpedo of the British Navy.

All the vessels enumerated above, from cruisers to submarines, are scheduled to be in service by the year 1931, but that the program will be fully completed by that date is rather doubtful. The first of the cruisers and destroyers are already behind time, and it is possible that the financial crisis may interfere with the

punctual laying down of new tonnage projected for the next two years. Even so, however, there are enough vessels actually under construction to ensure the presence in the Mediterranean of a powerful French fleet at a comparatively early date. While this new fleet of speedy, well-armed ships and efficient submarines may not be sufficiently powerful to guarantee the immunity of the Franco-African sea routes under all circumstances, its presence would render an attack on those routes a very hazardous proceeding, particularly in view of the strong air forces which would be available for cooperation with the naval defense. It would seem, therefore, that the prime objective of current French naval policy is within sight of attainment.

The Diesel in the French Navy.

The internal combustion engine is being rapidly developed in the French Navy, especially for boat work with the fleet and for small craft and auxiliaries, and considerable interest has been caused in Paris by the passage of the first of a new type of motor river gunboats on her way to the Rhine. She has been built at Brest and is known as the *Cannoniere Fluviale No. 1*, or C. F. I, having dimensions 60 x 12 x 4 feet draught on a displacement of forty tons. She is steel built and is, of course, absolutely flat-bottomed. She is propelled at a speed of ten knots by two semi-Diesel engines of 80 h. p. apiece. Her midship superstructure is loopholed for machine guns and carries two pieces, while a third is fitted on an anti-aircraft mounting in the after turret, the fore turret carrying a 37-millimeter one-pounder quick-firing gun of army pattern. The engine room is aft, the top being above the deck and protected with bullet proof steel, as is also the wireless room. A single mast, used only for the wireless and flash signalling, is placed right over on the port side of the superstructure. Apparently several more of these gunboats are to be constructed.

Naval Maneuvers in the Baltic.

Christian Science Monitor, 18 Sept.—A more than usual amount of naval activity has been taking place in the Baltic Sea this summer, especially toward the end. At least two sets of American destroyers have been exploring those waters this season, and now the United States battle cruiser *Memphis* is making a courtesy call at Stockholm after a tour through the historic "Eastern" Sea, as the Germans and Scandinavians call the Baltic. The Soviet fleet has also been active this summer in trial cruises and the execution of war games, and before winter sets in it is likely that a British squadron will make its appearance in those waters, where before the war the imperial German and Russian navies held sway.

But more than usually interesting has been the Baltic visit of an ultra-modern French naval squadron, consisting of destroyers and submarines, and most significant of all has been their operating far from home with the new Polish naval port of Gdynia (Gdingen) as a base. In naval circles this is a development that will attract wide notice and one that forecasts a number of possible complications. If Gdynia will serve as a Baltic Toulon—and such has been the frankly published program—the effectiveness of the French fleet in the north in a possible conflict over Danzig, or between Poland and Russia, will be greatly enhanced.

And a view of the French financial situation and the attitude toward the allied war debts, it is interesting to observe the reports that all these French naval war vessels are of the highest post-war types. The destroyers *Jaguar* and *Chacal,* leaders of the flotilla, are described as veritable dreadnoughts among the lighter kind of warship that has been so highly developed since the Washington agreement put an end to competition in armored cruisers. Of a lighter destroyer type France has eighteen, either completed or under way, and plans eighteen more, and of the submarine cruisers with eight torpedo tubes and a cruising radius of 7,000 miles, twenty-eight are planned for 1929, and nine are already completed. On the surface they can make seventeen knots, and thus follow a fleet at sea. But primarily, it must be admitted, the functions of such a squadron of light ships are defensive.

In general, naval building programs, as well as naval maneuvers, are expressions of national policies, and the concentration of so many naval units in the Baltic Sea but expresses the political preoccupation with those regions. Nowhere else in Europe does the peace structure of Versailles seem so frail as in the region of Danzig, and until Russia gives its consent to the various treaties registered under the League of Nations, whether a member or not, there can be very little security on the eastern shores of the Baltic.

The original French plan of an anti-Russian barrier from the Arctic to the Black Sea has failed on account of Finland's hesitation to join any combination whereby its own future would be jeopardized by the exposed position of Poland. Apparently, it prefers to approach its neighbors to the west, and in the final instance trust the friendly interest of England. At the same time the Soviet authorities have begun negotiations for peace and friendship pacts with each of the border states that before the war were parts of the Russian Empire. The naval demonstrations may be only the "atmosphere" to these parleys, and if left alone the diplomatists may score a victory for peace on the shores of the Baltic, as they have on the Rhine.

GERMANY

Germany's Occupied Territory.

New York *Times,* 18 Sept.—Some of Briand's Nationalist colleagues in the "Cabinet of Concentration" seem to fear the French Foreign Minister at Geneva is in danger of succumbing to a disease against which Viscount Grey has just issued a warning—"gush." Doubtless M. Poincaré does not subscribe to every jot and title of Briand's eloquent funeral oration over the grave of Franco-German hatred. This is largely a question of literary style. The Locarno treaties and Germany in the League are facts, and Briand's commentary is, as the legalistic Poincaré might say, *obiter dictum.* The situation is different with regard to the conversations between Briand and Stresemann concerning possible curtailment of the French occupation. Any change here would mean an alteration of the Treaty of Versailles, and Poincarist sentiment has all along insisted that the Locarno treaties and the Dawes plan are not substitutes for the Versailles Treaty, but designed only to facilitate its operation.

It is true that the Treaty of Versailles provides for a fifteen-year period of occupation of German territory west of the Rhine and the bridgeheads as "a guarantee for the execution of the treaty." Every five years, as Germany continues to fulfill her obligations, there is to be partial withdrawal of the occupying armies until the treaty is completely liquidated. Since neither Locarno nor the presence of Germany in the League is of itself a guarantee of German's fulfillment of treaty obligations, the German demand for curtailment of the occupation is regarded in Paris as illogical. But the section of the peace treaty dealing with guarantees has also this provision:

"If at that date [after fifteen years] the guarantees against unprovoked aggression by Germany are not considered sufficient, the evacuation of the occupying troops may be delayed to the extent regarded as necessary for the purpose of obtaining the required guarantees."

The allied occupation has therefore a double purpose: to enforce the execution of the treaty and to ward off the danger of German aggression. If France, after the complete fulfillment of Germany's treaty obligations, is still entitled to remain on German soil as a safeguard against aggression, then the reverse is arguable. Once the possibility of German aggression is removed, Germany is entitled to ask for a curtailment of the occupation period. It is a very legal mind, indeed, that will maintain that Locarno is no substitute for the Versailles Treaty. For the spirit embodied in the guarantee clauses of the Versailles Treaty the Locarno and Geneva spirit is undeniably a substitute.

Hindenburg Lauds New German Army.

New York *Times,* 19 Sept.—"I have seen today that the German army's traditional standard of spirit and skill has been preserved." These words uttered by Field Marshal von Hindenburg, President of the German Republic, at the close of today's maneuvers of the Reichswehr in the trolling hilly country south of this medieval watering place, set the final stamp of approval on the biggest war game played by Germany since the Armistice.

Spreading swiftly among the weary troops prone in their bivouacs, this tribute from the First Soldier of the Fatherland stirred a greater measure of enthusiasm than any ever pronounced by the Kaiser in the old days before the war.

President von Hindenburg was not a mere spectator but an active participant in the strenuous "hostilities" between Red and Blue armies composed, respectively, of the Fifth and Seventh Reichswehr Divisions—the largest armed force ever assembled at one point by the German Republic.

He started out with his personal staff at 7:00 o'clock this morning in an automobile from the old palace of the German Knights, which is his "billet" here, and motored along the lines of both divisions. Then he left his car and on foot inspected the infantry and artillery positions, hidden machine gun emplacements and cavalry concentrations. Frequently he stopped to question officers and men about the nature of their activities. Once he narrowly escaped being caught in a cloud of fog gas which is playing so important a part in this year's maneuvers.

The Field Marshal was in the best of good humor and evidently felt thoroughly at home among the troops, over whom under the German Constitution he exercises supreme command. He lunched quite informally with the divisional staff and repaired afterward to an observation post on top of a hill, from which the final engagement of the embattled forces could be best seen.

Here a special telescope had been set up for him. Defense Minister Gessler, General von Seeckt, head of the Reichswehr, and numerous high staff officers were with the President. A big table was covered with maps, which the President studied with the keenest interest. Subsequently the foreign military attachés also were brought thither and introduced to him. Major McLean represented the United States Army. The only other officer belonging to a nation formerly at war with Germany was the attaché of Soviet Russia, who wore the uniform of the Red army.

Since the mimic battle partook chiefly of the character of guerrilla warfare, being fought in small detachments of cavalry, infantry, machine guns, and horse artillery uphill and down, its progress was extremely difficult to follow. The sensational cavalry charges so beloved by William II at his pre-war maneuvers were

eliminated and the soldiers' movements were so cunningly concealed that as a spectator the operations were disappointing.

When early in the afternoon the Blue assault, having been deterred by "airplanes" consisting of toy balloons, went down in defeat and the bugles blew "Halt!" all along the line, the Field Marshal summoned the commanding officers about him and delivered a brief technical criticism of the day's doings.

One of those who heard him told The New York *Times* correspondent that he dispensed altogether with the flamboyant rhetoric emitted by the Kaiser on similar occasions before the war and contented himself with measured praise of the present army and an exhortation to maintain the traditions of the past.

ITALY

New Destroyers

The *Quintina Sella* returned to Naples from a "shakedown" cruise to the eastern Mediterranean on July 12, 1926. It is reported that the vessel performed very well in every respect and that only minor engineering difficulties were encountered. The last leg of the journey, from Sicily to Naples, was made on one engine because of the loosening of the propeller hub cap.

The oil-pipe-line lagging was found unsatisfactory in that it is combustible.

The *Sella* will remain at Naples for approximately a fortnight for minor repairs and adjustments, following which it will hold designed speed and full-power trials and then proceed on a cruise to the Adriatic prior to joining the fleet in September.

The *Crispi* has completed her acceptance trials, and great satisfaction has been expressed at the performance of her "Belluzzo" turbines.

The *Ricasoli* and the *Nicotera* are outfitting in the arsenal at Naples.

The following is the translation of an article concerning the 16 new Italian destroyers which appeared in the *Rivista Nautica Italia Navale* of June 15, 1926:

"With the month of July there will enter into service four of the sixteen destroyers, which, with military necessity, intuition, and promptness of decision, the high marine hierarchies have desired to augment the strength of our war fleet.

"The time has now passed in which every expenditure, every decision, every initiative in the field of the navy was, with demogogic thought which bordered on treachery to the security of the country, systematically obstructed and impeded.

"At the time the military ministers, under the influence of the democracy dominating the government, which lived in a con-

tinual fear of an unfavorable parliamentary majority, no longer interested themselves in technical questions which, in view of the continuous progress in the means of defense, came daily to the surface in the study of the problems regarding our armed forces; but it was their special interest to lose themselves in attempts to reduce expenditures, which efforts, if they were able to satisfy the deputies of that period, served to save the ministry and to carry out, with ever-increasing rapidity, the disorganization of our military organizations.

"This is the truth, not new really, but which is well to repeat and to bring to mind. In comparison of the present with the past there will be given judgment with greater facility and more justice to the enormous work of reconstruction by the national government. This is not a wasting of money on the part of the new administrators of the marine, but a judicious employment of capital which has its greatest and really immense return in the tranquility which, from might, it gives to the nation; in the profound study of marine problems; in the search of perfection of technical details, and finally in the example which comes from other naval powers, all of which have guided the Ministry of Marine in ordering the construction of the new units.

"Among the numerous decisions to be considered and taken for the reorganization of our navy, there was one which, more than the others, imposed itself and concentrated itself on an increase of our fleet adequate to future exigencies.

"Naturally, in the field of military critics, two tendencies in this regard manifested themselves: One, emanating from the experts, that greater security and power were found in the large battle units, provided with most powerful equipment, capable of independence in operation; the other, instead, had its adherents amongst those who, given experience by the teachings of the recent war and by the acute examination of future possibilities, did not wish superships, but agile units, light, speedy, and, at the same time, provided with good offensive means.

"This last tendency prevailed.

"The sea must be plowed with high speed. The quicker the offense the more effacious it is. And in speed there is also the greatest defense, for one may escape from an enemy lying in wait. Italian technique supplied the need admirably. From its study, from the ingenuity of the Latin mind, leaped out the types *Sauro, Sella,* and *Turbine.*

"Theory, happily, had accomplished its task.

"Practice must crown the work well begun.

"The same technicians began to lay down in the national dockyards the chosen and perfected vessels, the torpedo boat destroyers.

"After a relatively short time, because of the excellent preparation of the dockyards and the laborious activity of the builders, it was possible to launch the *Sella* and the other three foats of her class, the *Crispi,* the *Nicotera,* and the *Ricasoli,* which comprise the first series. These have three guns of 120 millimeters (4.7 inches), 45 calibers, four torpedo tubes, and one anti-aircraft gun. In other respects they are the same as the boats of the second series.

"The other twelve destroyers, of which the *Nazario Sauro,* launched on May 12 at Odero, is an example, will take the water, one by one, to form the homogeneous flotilla which in speed, armament, and independence are superior to all other flotillas of this class in our navy.

"The destroyer *Nazario Sauro* is the first of the second series of the new boats.

"Very sharp prow, flat poop, propellers widely projecting, it presents a very thin hull line.

"Draft, M., 3.25; length, M., 90.20; beam, M., 9.20; displacement, 1,300 tons at full load; 35 knots; but the effective speed will be greater because it is more powerful than the *Sella,* belonging to the first series, which produced a greater speed than that anticipated. The engines are 34,000 horsepower.

"The *Nazario Sauro* was designed and constructed in the Odero dockyard, where ultimately its twin, the *Cesare Battisti,* will be built, while the other two twins composing the squadron of the second series are found at "Quarnaro" of Fiume. These ships have two twin mounts of guns of 120 millimeters (4.7 inches), 45 calibers; two triple torpedo tubes of 533 millimeters (21 inches); and three anti-aircraft rifles of 40 millimeters, situated one on the poop and the others nearly at the center of the ship at the base of the search-light platform.

"The four destroyers of the second series (*Battisti, Sauro, Manin,* and *Nullo*) were constructed from designs of the dockyard Odero, and more particularly by Engineer Eurico, who directed personally the launching of the *Nazario Sauro.*

"In the dockyard Odero at Sestri Ponente, aside from the before-mentioned *Cesare Battisti,* which will be launched toward the end of July, there is under construction a destroyer of the third series, the *Turbine,* which series has 1 knot more speed than the others.

"Belonging to the third series are also the destroyers *Aquilone,* which will be built by Odero, the *Borea,* the *Zeffro,* the *Espero,* the *Ostro,* laid down in the Ansaldo dockyard at Sestri Ponente, and the Nembo and the Euro, entrusted to Piaggio at Riva Trigoso."

JAPAN

Another Russo-Japanese Conflict

From the Japanese Press, 17 Aug.—An American dispatch reports that the Institute of Politics at Williamstown, Massachusetts, held a meeting lately, when another Russo-Japanese War was predicted, and that a certain speaker announced that the conflict could by no means be avoided. It seems that the speaker arrived at such a conclusion from the misleading editorials of English papers in the Far East, which are in the habit of pointing out that Russo-Japanese relations in Northern Manchuria have recently been strained and also of magnifying alleged possibilities. Americans in the United States are not well informed of political conditions in the Far East, so they are soon misled by dubious reports. They appear to be of the opinion that the conflict is a question of time. The alleged possibilities are a dreamy vision, and we shall pay no attention to this American fantasy.

However, we question whether or not there is any cause for a dispute in Northern Manchuria. We do not think that one can reply in the negative. The Soviet Government formally manifested its intention of relinquishing all privileges granted to Tsarist Russia, but it has evidently an ambitious plan as regards Outer Mongolia and Northern Manchuria. The Soviet nation is not on friendly terms with China and her zeal for the restoration of her national rights, whereas Russia is jealous and suspicious of Japan's economic activities in those regions.

Russia's interests and influence are represented by the Chinese Eastern Railway, while those of Japan are maintained by the South Manchuria Railway Company. Rivalry between Japan and Russia is the competition between the Chinese Eastern Railway and the South Manchuria Railway. The construction of the Taonan-Tsitsihar Railway throws a dark shadow over Russo-Japanese friendship.

Soviet Russia does not find herself in circumstances to pursue the ambitious imperialism of the Tsarist Government, because she has not enough strength to make her might felt throughout the Far East. She knows her own difficulties, so she lodged a protest with the government of China with reference to the question of the Taonan-Tsitsihar Railway, and did not go any further. Relating to the Chinese Eastern Railway affairs, Russia was so conciliatory as to change its general manager. Drastic though Russia's policy is, she is anxious only to maintain her old influence in Northern Manchuria and Mongolia, and will be content with success in that policy. Soviet Russia will no longer be so venturesome as to challenge Japan. From these contentions we conclude that the American opinion is an unusual fantastic dream.

We dismiss such an opinion as silly, but do not deny that a cause of danger exists. We venture to advise the Imperial Government to be cautious and moderate in its policy toward Manchuria. Soviet Russia is extremely anxious about Japan insofar as Northern Manchuria is concerned. Japan must not be indifferent toward Russia. The interest involved in the Taonan-Tsitsihar Railway is local, whereas relations with the Soviet nation are national. National interest must not be sacrificed for the sake of local affairs. The prediction that Japan and Russia will fight again is an extraordinary opinion and well informed circles will not believe in it, but undue zeal over the importance of the South Manchuria Railway and excessive influence of military ideas relative to the policy of Manchuria and Outer Mongolia will constitute a cause for dispute.

Air Force's Importance

Tokio *Nichi Nichi,* Japan *Advertiser,* 24 Aug.—Which is more important, the flying corps or the army? They are like young men and aged folks. Both are important.

Air forces are compared to young men. They must assume the important rôle of tactical operations, while the army and navy ought to take up strategical duties so that they may afford the air forces bases of operations. The functions devolving upon air forces are to assist the activities of the other two arms, simultaneously hampering the tactical operation of the enemy by attacks from midair. In this sense air forces are dominant over the field of warlike operations. No other weapon is so efficient as flying machines. An experiment of the United States Air Forces shows that flying machines can sink capital ships by bombs dropped from midair, although an air attack upon an incompleted battleship of the newest type in November, 1924, was unsuccessful. It is evident, however, from experiments that battleships are no match for flying machines in the future. Granting that battleships of the best type can resist attack from the air, warships of the other classes have no power of resistance against attacks by flying machines. For these reasons the navy, however strong, can not hold out against attacks from midair from strategic point of view.

The percentage of hits by aerial attack is put at twenty-five, which is higher than that of gun fire. Flying machines may take advantage of the morning twilight to hinder the sight of an opponent fleet by means of poison gas, smoke shells, and smoke barrages and to launch an attack. Such bombing or torpedo attacks will not fail to be efficient. The only weapon ships have is anti-aircraft guns. The United States Navy tries hard to make it appear that the efficiency of its anti-aircraft gun is high, but this

is an exception. As a rule, anti-aircraft guns can not resist the force of flying machines. The tactical efficiency of air forces, can no longer be ignored.

Their weak point is that they can not fly for many hours continuously. However formidable they may be, flying machines must come back to their base of operations after action without loss of time. It is the navy or army that gives the base of operations to flying machines, just as aged folks laboriously establish a social basis for young men to make their base of activities. Thus it is seen that the necessities of the navy, army and air forces are closely co-related.

The imperial Navy authorities attach too great an importance to the construction of auxiliary ships in sweeping condemnation of flying machines. They are evidently mistaken, in our opinion. Auxiliary ships without the help of flying machines will, as General Nagaoka contends, be exposed to danger. Aircraft are called 100-mile guns, because they can deliver an attack long before capital ships enter the zone of action. Flying machines are so efficient and formidable that their construction must be earnestly considered simultaneously with that of ships. The Ministry of Finance curtailed the estimates of the navy authorities for the following fiscal year, in consequence of which one air corps and a half can be organized, whereas the expenditures necessary for naval air service have also been reduced. Even if these estimates be accepted in full, they will not exceed the funds requisite for the construction of one or two destroyers. The curtailment by the Finance Ministry is wrong. Such a policy can not be justified.

Japan to Foster Commercial Aviation

Aviation, 20 Sept.—That the Japanese Government is about to launch an ambitious plan for the development of commercial aviation is among the most interesting pieces of aeronautical news at this time. The information takes on an event greater significance when cognizance is given to the attitude recently adopted by the Japanese representative at the preliminary Disarmament Commission in Geneva when the question of the value of the commercial airplane in military service was brought up for consideration. While agreeing that there is a possible potential military value in the commercial airplane, it will be recalled that the report of the preliminary commission stipulated that commercial aviation should be permitted to develop freely, its military value being considered only in the event of further steps being taken towards aerial disarmament.

The new Japanese budget provides for the expenditure of 22,000,000 yen, which is approximately $11,000,000, on the development of commerical aviation over a period of seven years.

The money is to be spent in providing air navigation facilities and in subsidizing a private company by a direct grant or on a mileage basis for air mail routes between Tokio and Osaka and Osaka and Dairen. It is of interest to note that the distance between Tokio and Osaka is approximately 220 miles and that between Osaka and Dairen, 850 miles. Moreover, the latter route involves the passage over a considerable stretch of water, the Korea Strait and a corner of the Yellow Sea. It is a very long and, it would seem, difficult route and no information is given as to the stops to be made or whether seaplanes or land machines are to be used.

The significance of the Japanese civil aviation proposals may be realized by a comparison, for example, with the British subsidies to civil aviation. The Air Ministry's 1926-27 civil air estimates amounted to approximately $2,310,000 which, at this rate, would indicate an expenditure of over $14,000,000 for seven years, assuming no change in the estimate. Of this estimate for the present year, about $835,000 is for subsidy payments to the Imperial Airways European lines and the proposed Egypt to India line to start in January, 1927.

Thus, it will be seen that Japan is entering whole-heartily into the development of commercial aviation, in the proposed two lines which are to be inaugurated. These will form a grand trunk air line across the islands which constitute Japan and will link the country with China and its colonial possessions on the Asiatic continent. Coming, as it does, as the first serious indication of commercial aviation development in Japan, the recent announcement can only be regarded as tremendously significant of the attitude adopted by Japan in aeronautical development problems.

SPAIN

Future Construction

On August 9 the King signed a decree law authorizing the expenditure over a 10-year period of 877,629,935.31 pesetas (about $140,000,000) for Spanish naval construction.

The desirability of effective measures for the rehabilitation of the Spanish Navy has long been apparent, and the present decree is merely indicative of the natural solicitude of the dictatorship for the adequate defense of the country. Moreover, the insufficiency of the present naval establishment was emphasized during the recent hostilities in Morocco, when the Spanish Navy would, it is believed, have proved unequal to the tasks imposed upon it had it not been for the assistance rendered by French war vessels in patrolling the coast. To provide Spain with a navy of a strength commensurate with the importance of the country is but a logical step to furtherance of General Prime de Rivera's program of

catering to Spanish national pride and fostering the growth of the spirit of nationalism.

It will be noted that the largest vessels to be constructed under this appropriation are three cruisers of the *Washington* class, having a tonnage of 10,000 tons each. Provision is also made for the building of three destroyer flotilla leaders, twelve submarines, two oil tankers, and three patrol boats. It is understood that the construction of these vessels will be undertaken by the naval shipbuilding plant at Ferrol.

It will be seen that the effort that is being made by Spain to improve her defensive means is quite considerable, due consideration being given to aerial defense. The main points of this program are the creation of the aero stations at Mahon (Balearic Islands), Cartagena, and Vigo, and the construction of three cruisers of 10,000 tons and twelve submarines. The construction of one cruiser of 7,850 tons and three destroyers is also included in the above expenditure.

From the above authorization it will be seen that the Spanish Government is taking upon itself a considerable debt. In the original budget for 1926 (six months—to January, 1927) the above naval expenditure was not mentioned. It is believed that the reports upon budgets are issued in this manner in order to confuse the general public upon a real state of finances of the country. Instead of making a more favorable showing the government is becoming more hopelessly involved in debt as time progresses.

CHINA

Chinese Anarchy

London *Times,* 9 Sept.—The publication by the Admiralty of the names of all ranks of the King's Navy who were killed or wounded in the recent encounter with Chinese troops on the Upper Yangtze is a painful reminder of the constant jeopardy in which British lives and liberties are placed by the continuance and the extension of Chinese anarchy. For years past various Chinese generals have been in the habit of violating the treaty rights and laying lawless hands upon the property of foreigners in the disturbed areas of the distracted Republic. Protests and appeals to the so-called Central Government have been useless, except where some super-Tuchun, nominally under the control of that powerless body, but actually its master, has been persuaded by Peking or by his own intelligible desire to avoid complications, to compel his subordinates to drop their prey. On the Yangtze River, the great commercial artery of Central China, British merchant vessels have time and again been fired upon by contending militarists and boarded by disorderly soldiers who have called upon the captains to

convey them free of charge from one river port to another. Until now the intervention of British Consuls with the local Tuchuns has usually been successful; when the Tuchuns were obstinate the British Navy intervened: a river gunboat appeared and ordered these undesirable passengers off the ship which they had seized. These and similar demonstrations were long endured by the British Government with Christian forbearance. Every allowance, perhaps too much allowance, was made for the weakness of Peking and for the difficulties of administrators. But the Chinese Central Government, though it is a member of the League of Nations, has not understood the obvious fact that international obligations are bilateral. It has demanded the abrogation of treaties which it considers onerous and the abolition of foreign extra-territorial privileges which it regards as infractions of its sovereignty, but it has done less than nothing to prove to the important foreign communities established in Chinese ports that their loss of the protection which they now enjoy will not expose them to more extensive military exactions, if not to worse things. But while it incongruously aspires to a permanent seat on the League Council, it is dematerializing—to employ a spiritualistic phrase—with alarming rapidity, and local rulers, in many cases self-seeking bandits or lawless and faithless adventurers, defy or neglect its orders.

The latest outrage which brought about the collision between the British gunboats and the troops of General Yang Sen was exceptionally provocative. This warrior, who is one of Wu Pei-fu's subordinates, first fired upon and seized the *Wanliu*, a British steamer, whose captain was compelled by threats to convey 300 soldiers to another port. An accident which befell two barges crowded with soldiers while the ship was leaving the port furnished the general with a pretext for seizing two other British steamers, for imprisoning their officers, for threatening and immobilizing a small British gunboat, and for refusing to withdraw his men from the captured ships except on conditions which would have permitted him to extort compensation from the company owning the vessels without any regard to the facts of the case. Appeals to the Central Government, to Wu Pei-fu, who was otherwise occupied, and to General Yang himself were unavailing, and the naval forces were at last compelled to rescue the six prisoners by force. Five of them were saved by the self-sacrificing courage of the British sailors. One apparently was drowned while swimming towards a French gunboat. It was impossible to "cut out" the two captured ships owing to the heavy rifle and artillery fire directed on the British vessels, but the principal object of the action was obtained. Regrettable as was the loss of life in this encounter, it is obvious that the rescue of fellow-countrymen from

the clutches of one of the military bandits who infest China was the imperative duty of the British authorities. Any failure to attempt this task would have exposed British subjects in the Yangtze valley to worse dangers than mere spoliation. It is to be hoped that the Cantonese Government will take the lesson of the Wan-hsien encounter to heart. Instead of protesting further against the action of the British Navy, which has unkindly prevented the Canton strike pickets from indulging in their pastime of firing at the boats carrying passengers to and from the daily steamer from Hong-kong to Shameen, it will do well to set its house in order and to remember that there are limits even to British patience, and that the commerce of Canton, is even more vulnerable than that of Hong-kong.

But prudence is not the predominant virtue of the Southern "Reds." Flown with his success over Wu Pei-fu, who has abandoned Hankow and its neighboring cities and retired to the north with the few loyal troops left him, Chang Kai-shek, the Cantonese Generalissimo, and his Russian adviser, General Gallent, have now opened a perfectly gratuitous campaign against Sun Chuan-fang, the Shanghai Tuchun, with whom they are disputing the province of Kiangsi. Sun may be a harder nut to crack than Wu; Wu may return as he has returned before; Chang Tso-lin is said to be discussing the dispatch of Fengtien troops against the rival Chang, but nothing daunts these optimistic adventurers, and there is every indication that the Lower Yangtze valley will soon be the theater of fresh hostilities. There can be no question for this country of taking sides with any of these factions. The British Navy has taken action against one of the henchmen of the "Anti-Red" Wu (who is one of the few supporters of the shadow government of Peking) and against the strikers, who are the protégés of the "Red" Government of Canton. But no British Government can be indifferent to the spread of anti-British propaganda and of militarist anarchy in Central China. The threats of the Soviet press against Chang Tso-lin and the violence of its attacks upon the British and Japanese Governments suggests that the Bolshevists hope to profit by the early intensification of the existing confusion. So far the powers most interested in the pacification and in the mending of broken China, if that be possible, have failed to reach any agreement as to the means whereby such desirable ideals may be realized. Their failure cannot be imputed to this country, which has the best commercial reasons for desiring the reestablishment of order and security. An extension of the civil war may force the powers to agree on a common policy. It will certainly oblige this country to redouble its efforts to defend the rights and the safety of its nationals in Chinese territory. Our Peking correspondent's statement that Mr.

Lampson, who has imagination and personality, is to be the next British Minister in China, may justify the hope that His Majesty's Government will soon be able to adopt a more positive policy in the Far East, where British inactivity has not always been masterly.

ENGINEERING

Corrosion—Its Cause and Cure

Power, 28 Sept.—Corrosion of ferrous and non-ferrous metals in all industries is enormous despite the earnest endeavor of a great number of investigators to control these losses. The factors that influence corrosion of metallic substances are numerous and, for this reason, difficult to control. The investigations of this subject during the last few years have thrown much scientific light upon the fundamental principles upon which corrosion proceeds.

While corrosion of metals may not be completely eliminated, the problem can be controlled in most cases. This may be accomplished: (a) By careful processing in the manufacture of the metal, (b) by preservation of the surface as a result of protective coatings, (c) by controlling the substance coming into contact with the metallic surfaces. In the present article the discussion on this subject will be confined primarily to the last two phases of the problem, since it is these which are intimately related to feed-water treatment.

In the case of boiler and auxiliary equipment high temperatures and pressures are factors in the acceleration of corrosion that are present to a lesser degree or not at all when the corrosion proceeds at atmospheric temperature and pressure.

The resistance of non-ferrous objects (such as condenser tubes) to corrosion is related closely to the composition of materials used and is the most important single factor to be considered. Non-condensible gases released from water in boilers are probably the greatest single agency to be considered in the corrosion of boiler tubes and drums and the corrosion of economizers and superheaters.

Theories of Corrosion

During the last century many theories have been proposed to account for failures due to corrosion. The acid theory was put forward more than fifty years ago and for a time had many supporters. It was contended by those who advanced this theory that three factors influence the phenomenon, namely, an acid, water, and oxygen. Experimental studies have shown the acid theory to be not entirely sound, since corrosion can proceed rapidly in the absence of carbonic acid or other acid provided the metal is in contact with water containing oxygen.

The biological, the film, the peroxide and the direct-oxidation theories have been conceived by different investigators. These may account for the corrosion phenomenon that takes place in specific cases, but they are not sufficiently broad to indicate the basic or fundamental conditions upon which the corrosion of metal proceeds.

The electrochemical theory was suggested about twenty years ago by Whitney and has since been confirmed by a number of other investigators. It is now accepted generally as a sufficiently satisfactory explanation of the basic reactions that are responsible for the corrosion of ferrous as well as non-ferrous metals. The theory is somewhat complicated and involved. Briefly, however, it may be explained as follows:

All metals in contact with water have a specific solution tension, that is, they exert the power to go into solution. When this reaction takes place, the metal that has dissolved in the liquid is in the form of ions.[1] This action may take place when the metal and water are chemically pure. Under these conditions the rate at which the metal dissolves is very slow. The solution tension is influenced greatly by impurities in the metal and in the electrolyte.[2] The solution of pure iron in water according to this theory takes place as follows:

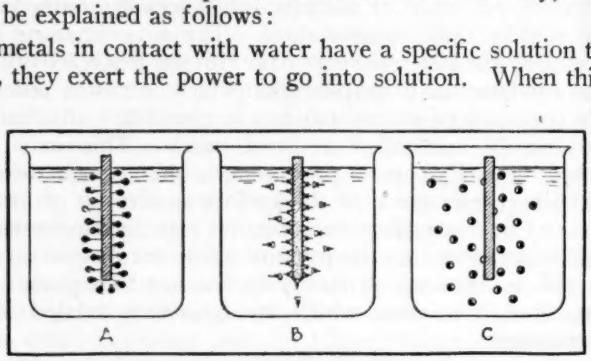

FIG. 1—ELECTROLYTIC THEORY OF CORROSION ILLUSTRATED

A—Iron ions passing into solution. B—Hydrogen ions depositing on the iron, polarizing (blanketing) the metal. C—Oxygen dissolved in water removing hydrogen by uniting chemically to form water. This permits more ion to pass into solution.

Iron dissolves only by displacing another metal that is already in solution in the electrolyte. This may be noted by submerging iron in a copper solution. When this is done, the iron goes into solution in the electrolyte and the copper is deposited upon the iron.

[1] Atoms or atom groups carrying charges of static electricity. If the ions have a positive charge, they are termed cations and if they carry a negative charge, anions.

[2] When the metal is in contact with water, the water is the electrolyte.

Water (H_2O), when ionized, forms hydrogen ions $\overset{+}{H}$ and hydroxyl ion $O\overline{H}$. The iron in contact with the water goes into solution as ferrous ions, and an equivalent number of hydrogen ions (the hydrogen being considered a metal) are discharged and plated out upon the surface of the iron. The ferrous ions in contact with the $O\overline{H}$ ions form ferrous hydroxide. In the presence of oxygen ferrous hydroxide is oxidized to ferric hydrate (ordinary red rust).

When the hydrogen deposits upon the surface of the iron, the metal is polarized and no further corrosion of the iron results until the layer of this gas is removed. In the presence of oxygen the hydrogen is removed, combining chemically with the oxygen to form water. The hydrogen may be removed also by passing away as a gas. In these ways the hydrogen is removed as it forms and the corrosion is progressive.

In the presence of oxygen the iron that has gone into solution in the water in contact with the metal is readily oxidized, forming the insoluble compounds known as rust. When rust deposits form on iron, the corrosive action is somewhat retarded since these may act as a protective coating. Corrosion of iron is not entirely prevented, however, by these rust deposits.

Practically all natural waters contain oxygen and as such are corrosive to a greater or lesser degree. As has been stated previously, the rate of solution is affected by the impurities in the metal and in the electrolyte. Because of these facts, the solution tension is considerably different at different portions of the material. The solution tension is increased in some areas and decreased at others. Owing to these conditions electric currents may flow from one area to another, the electrolyte serving as the conducting medium. This is equivalent to the action of an ordinary wet-cell battery. The metal passes into solution in the electrolyte at the electro-positive areas (the anode), the hydrogen ions migrating to the negative areas and the hydroxyl ions to the positive area.

Dissolved Oxygen and Corrosion

From the foregoing discussion it will be noted that oxygen dissolved in water has considerable effect in accelerating corrosion. The effect of dissolved gases in accelerating corrosion and the problem of oxygen removal has been discussed in the article dealing with deaërators. The rate at which corrosion proceeds in boiler waters containing a specific amount of oxygen will not be

[1] For the purpose of illustration the formula for water may be written HOH, which ionizes to $\overset{+}{H}$ and $\overline{OH}$.

the same in all cases. This condition is influenced by the hydrogen-ion concentration of the water (acidity), the incrusting solids in the water supply, the method of operation of the boiler and many other factors, all of which affect to a marked degree corrosion losses.

Corrosion Due to Mineral Acid

At times feed-water supplies are contaminated by mineral acids or, stated more accurately, the non-oxidizing acids. In this class are hydrochloric, nitric, sulphuric acetic, and other acids which are present at times in surface water in appreciable quantities as the result of trade waste discharged into the feed-water supply. Mine drainage is responsible frequently for the acids in feed water, since many mine waters have a high acid content. The presence of these so-called "strong acids" causes rapid destruction of boilers, the corrosion appearing in the form of pitting, which, if not checked, rapidly destroys the metal.

Alkalinity of Water and its Effect on Corrosion of Iron

The effect of alkalies on the corrosion of iron is clearly stated by Speller in his book which has been published recently. "Alkalies, as is well known, cause a retardation in the corrosion rate of iron, which diminishes to a certain minimum as the concentration of the base increases. This general fact has been well established by experience and tests. In the works of diffierent investigators there is some disagreement, however, about the extent of the inhibiting effect. The lack of agreement is not surprising, as the rate of corrosion is influenced by a number of factors other than alkalinity, such as the film-forming properties of the waters, rate of motion and temperature. Hydroxide alkalinity is much more effective than carbonate or bicarbonate alkalinity."

Carbonic Acid

The most important non-condensible gas next to oxygen considered from the standpoint of accelerating corrosion, is carbonic acid. In small amounts in feed water this gas has no appreciable effect, since there is usually sufficient alkalinity present in the concentrated boiler water to neutralize the acidity produced by the increased hydrogen-ion concentration as a result of ionization of the carbonic acid. Relatively high carbonic-acid content in the feed water or bicarbonates, which will release carbonic acid under the influence of heat, may cause severe pitting of tube or drum of boiler. Even though no corrosion may take place in the boiler, the carbon dioxide discharged from the boiler with steam may cause active corrosion of turbines and auxiliary equipment. Cor-

rosion occurring in steam pipes may be traced frequently to this source.

Some feed-water supplies contain organic acid or organic compounds which, under high steam temperatures and pressures, are converted into acids. These conditions are the result usually of trade-waste pollution of the feed-water source, although they may be present as a result of drainage from swamps or marshes. Most of these compounds are volatile, and therefore particularly objectionable since they pass from the boiler with the steam, causing active corrosion of steam piping and other parts of the system. A case of this kind was investigated by the writer where pollution of a feed-water supply by organic wastes discharged from a mill caused the destruction of steam piping amounting to over $20,000 in one year, owing to the corrosive action of the steam contaminated by organic acids.

Acid Produced from Salts in Feed Water

There are many salts dissolved in water which, under the influence of heat, produce acids. The most important salt in this respect is magnesium chloride. It appears that magnesium chloride breaks down into the hydrate and hydrochloric acid. The acid generated then attacks iron, forming iron chloride. There then follows a further reaction between the iron chloride and the magnesium chloride, forming iron hydrate (rust) and magnesium chloride again.

It will be noted that a relatively small amount of magnesium chloride in a water supply may become a source of active corrosion since the reaction is cyclic and under the above regenerative condition the corrosion cycle may go on indefinitely.

Sodium chloride (common salt) alone is not actually corrosive, but in the presence of magnesium sulphate reacts with the latter to form magnesium chloride. The magnesium chloride becomes actively corrosive unless neutralized by a sufficient amount of an alkaline salt. If the alkalinity is due to caustic soda, the magnesium chloride will react with it, forming sodium chloride and magnesium hydrate, thus inhibiting the corrosive properties of the magnesium chloride.

Magnesium carbonate or magnesium nitrate in the presence of sodium chloride may generate acid, the former giving hydrochloric acid and the latter nitric acid. Silica and sodium chloride in the presence of steam will produce hydrochloric acid and sodium silicate. Although this reaction is possible, it is doubtful if the condition results in boiler waters except under unusual conditions.

Although this condition is found only infrequently, water high in ammonium chloride may cause corrosion of boilers and appur-

tenances. A case where boilers were seriously corroded from this source was called to the author's attention recently. Many feed-water problems relating to corrosion may be traced to the production of acids due to the reaction of the various salts concentrated in the boiler water.

As a rule, scale formation will reduce corrosion, since the deposited salts mechanically protect the metal and prevent actual contact with the corrosive agent and the metal. Under some conditions, however, corrosion may take place beneath the scale or even under a protective coating which has been applied to protect the metal surfaces. When this action takes place, the corrosion is generally in the form of "pitting" and often progresses without attention.

Prevention of Corrosion in Steam Boilers

Since many factors influence the rate of corrosion, no general treatment may be offered for correction of this trouble. This condition holds true particularly for the destruction of metal of steam boilers. Many forces are encountered under these conditions that are not present where corrosion proceeds at atmospheric temperature and at normal pressures. Summarized briefly, the principal factors influencing steam-boiler corrosion are as follows:

(1) The presence of gases in the feed water, particularly dissolved oxygen.

(2) The hydrogen-ion concentration (acidity or alkalinity) of the feed water.

(3) The velocity of the water passing over the metal.

(4) The temperature and pressure maintained in the boiler.

In considering corrosion, preventive methods for deaëration or deoxygenation of the feed water is essential to inhibit pitting or general corrosion of the metal in contact with the feed water. Methods employed for this purpose have been previously discussed in the chapter dealing with deaëration. Irrespective of the other agencies accelerating corrosion oxygen is by far the most important factor to be considered. Not all corrosion will be arrested even when the feed water has been completely freed from the dissolved oxygen. Reduction of the oxygen content of the water to one cubic centimeter per liter or less will reduce the corrosive properties of the water greatly. The presence of a given amount of oxygen in one feed water may show no noticeable corrosion, while the same amount under other conditions might be actively corrosive. Under some conditions incrustation will completely arrest corrosion from oxygen in the feed water, even if the oxygen content is excessive.

Reciprocating pumps are responsible frequently for entraining relatively large amounts of oxygen in the feed water, after the

supply has been deaërated. Contamination of this kind occurs usually with old pumps, and it is often difficult to correct the trouble, since some oxygen is sucked into the pumps even when the packing glands are made as tight as possible. See Fig. 2 which summarizes tests made by the author.

Below 750° F. the amount of gas production by dissociation of water is probable negligible. Above this temperature conditions may occur in which gas production may be relatively rapid. The possibility of the production of hydrogen or oxygen at high temperature has an important bearing on corrosion, embrittlement or

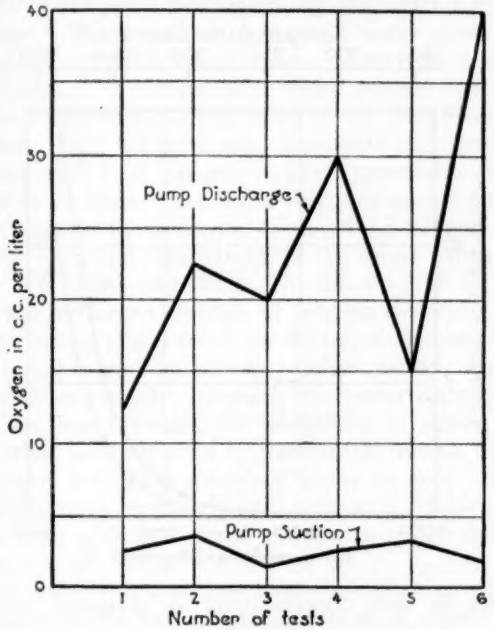

FIG. 2.—EFFECT OF ENTRAINMENT OF OXYGEN IN FEED WATER BY A RECIPROCATING PUMP FEED WATER, AFTER THE SUPPLY HAS BEEN DEAËRATED. CONTAMINATION OF THIS KIND OCCURS USUALLY WITH OLD PUMPS, AND IT IS OFTEN DIFFICULT TO CORRECT THE TROUBLE.

other operating difficulties. These troubles may not only affect the boilers, but extend to the superheater, turbine, condensers, and elsewhere in the steam cycle.

The hydrogen-ion concentration of a water is a measure of the ionized hydrogen or the active acidity or alkalinity of the water. High concentration of hydrogen ions tends to increase corrosion of metal. Stated briefly, this condition is due to the fact that an increase of hydrogen ions means a higher acidity of the water, which accelerates the deposition of atomic hydrogen. Atomic

hydrogen deposits as the iron ions go into solution in the water, and for each ion of metal that passes into solution there must be deposited or plated out one electrical equivalent of hydrogen. Any agency that increases the rate of deposit of hydrogen on the metal permits an increase in the solution of the metal. This phenomenon is influenced by many factors that may not be discussed here, since they are somewhat involved.

It is interesting to note that the ionization of pure water increase with rising temperatures, so that at from 600 to 700° F. water is distinctly acid, as indicated by the hydrogen-ion concentration. This condition is one of far-reaching importance in high-

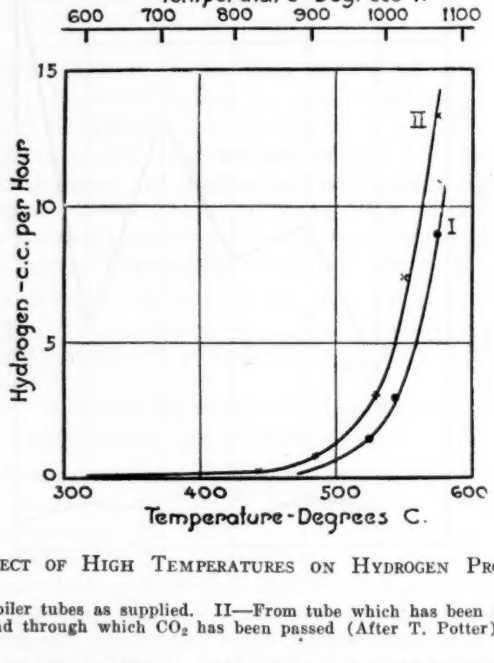

FIG. 3.—EFFECT OF HIGH TEMPERATURES ON HYDROGEN PRODUCTION IN BOILERS.

I—From boiler tubes as supplied. II—From tube which has been heated to over 600 deg. C. and through which CO_2 has been passed (After T. Potter).

steam-pressure installations. Fig. 3, showing the influence of the hydrogen-ion concentration on the corrosive properties of water at 71 and at 104° F., is reproduced from studies by Whitman, Russel, and Altrere.

It has been accepted, generally, that the velocity of water in passing over metal greatly accelerates the rate of corrosion. There are a number of factors that may account for this condition. Generally, however, the increase in corrosion is due to the fact that the rapid movement of water over the surface brings much greater amounts of oxygen in contact with the metal than would result only from diffusion.

It is common knowledge that hot water is generally more corrosive than cold water. This condition is due to several factors, the most important of which is the release of oxygen as the temperature increases. Under conditions where a fresh supply of oxygen is being constantly released from the water, the corrosion will be exceedingly rapid. Since temperature is only one of many factors to be considered in the mechanism of corrosion, it is difficult to allocate the part it plays.

Hydrogen-sulphide, ammonia, sulphur dioxide, and many other gases may be present in surface water employed for feed water purposes. Of these gases hydrogen-sulphide and chlorine are the most important. The former is present in water generally as the result of trade-waste pollution or from decomposition of sulphate by biological action. Chlorine is at times present due to overdosing water with chlorine solution used in the treatment of public water supplies. Both the gases may accelerate the corrosive properties of water greatly if present in any appreciable quantity.

The majority of boiler-feed-water supplies owe their corrosive tendencies largely to the presence of dissolved oxygen. It is because of this fact that deaëration is the most effective means available for preventing corrosion. No definite limit may be established as to the minimum amount of oxygen that may be present in a supply to insure a non-corrosive water, since complete inhibition is not possible and since many other factors influence the result. Considered broadly, however, the nearer complete removal is obtained, the less becomes the possibility of active corrosion. Deaëration, when accomplished by mechanical means, removes not only the oxygen but other dissolved gases as well. Mechanical deaëration sometimes results in the reduction of bicarbonate to normal carbonate with a material reduction of the hydrogen-ion concentration.

When feed water contains free acids or salts that may be converted into acids under the influence of heat, it should be treated outside the boiler. In the case of non-oxidizable acids these should be neutralized with non-scale-forming alkaline salts. In the case of magnesium chloride sulphates, or nitrates, softening or evaporation of the feed water will correct the potential corrosive properties of these waters. Frequently, however, these salts enter the boiler through leaky condensers. Where such conditions exist, correction of the acidity produced may be effected by treatment of the boiler water with non-scale-forming alkaline salts, by dilution of the boiler water by blowing down or by emptying the boiler and refilling with fresh water.

Adjustment of the hydrogen-ion concentration (acidity) may be obtained most satisfactorily by means of hydrates and carbonates of alkalies. Caustic soda or soda ash is generally em-

ployed for this purpose, although in some instances trisodium phosphate or other sodium compounds are preferable. Chromates are used in some cases to inhibit corrosion. Speller points out, however, that chromates are not well adapted for use with boilers since they are affected by heat. The same author directs attention to the fact that chromates react with soluble chlorides, producing hydrochloric acid.

A counter-electrical potential to inhibit corrosion has been used to some extent in this country and abroad, and from a theoretical viewpoint it has merit. A number of installations of this kind have been put into service. There is much still to be learned concerning the practical application of this method.

Conclusions

In years past, lack of knowledge of the mechanism of corrosion was responsible in many instances for the rapid destruction of boiler and appurtenances. This condition no longer exists, and many corrosion problems affecting boilers may be reduced to a negligible degree by deaëration of the feed water and by well chosen and efficiently operated feed-water treatment systems. In some respects corrosion problems are more acute than a few years ago. Higher steam temperatures and pressures have introduced new factors that formerly did not exist or at least were present to a lesser degree. Removal of scale-forming solids from feed water has produced a condition favorable for corrosion of boilers in such a case, since the protective coating of scale has been eliminated.

An Engine That Runs on Dust

Power, 14 Sept.—The Bureau of Chemistry is studying the causes of dust explosions in industrial plants and developing methods of control and prevention. It is now generally recognized that one of the main problems in connection with the operation of grain elevators is the matter of effective dust collection and disposal. In order to reduce the hazard of dust explosions, the grain dust must be collected and not be allowed to settle throughout the plant. In elevators where the dust is now being collected by mechanical means, a definite disposal method must be devised. The tremendous power generated and dissipated in a grain-dust explosion, suggested a potential supply of fuel for an internal-combustion engine.

During the fall of 1925 a miniature grain elevator was used at the National Exposition of Chemical Industries in New York City to show the ease with which dust may be oxidized and exploded by means of an electric spark. After hundreds of successful explosions had been produced in this device, the probability of ex-

ploding such dust in an internal-combustion engine was suggested.

If an internal-combustion engine connected to a generator could be designed to use this waste material, an obvious power charge saving could be effected in the plant operation and much cleaner elevators would result, especially among the small country elevators. In order to determine this possibility, the work referred to in this report was undertaken. A Ford engine was procured and blocked up. The carburetor was taken off and to the intake manifold was attached a metal tube which connected the engine with a chamber. This chamber was equipped with a small fan and re-circulating pipes, so that air could be drawn out of the top of it and blown in at the bottom, thus producing an up-draft which was designed to keep the grain dust introduced into the chamber, in suspension. Check valves were placed in the tube as a safeguard against back-fire. To avoid hand cranking, an electric motor was used to drive a pulley on a shaft connected to the rear of the engine.

Compression was another hindrance to maintaining a good dust cloud over the piston. Quite likely the suction stroke of the piston drew in a sufficient amount of dust to produce a good explosion, but during the compression stroke the dust settled on the top of the piston before ignition occurred and so failed to fire. To get a hot spark a Bosch ignition system was installed, using a 1½″ spark coil and eight dry cells. Being unable to explode the dust in the engine with this arrangement, the head was taken off and a larger combustion chamber was provided. These chambers were made by forging a piece of 6″ pipe into shape to fit around the cylinder and valves in the top of the block. A $^{5}/_{16}$″ clear wire-glass plate was clamped over the top of one chamber for observation purposes, while the other was covered with a steel plate. Spark plugs were fitted with points extending into the center of the chambers and making contact with terminals that were fitted in the heads of the pistons.

The magneto ignition system, induction coil, and dry cells were replaced with the regular Ford distributor and a lamp bank of six amperes using 110 volts direct current from the power line of the laboratory.

The manifolds were removed and the dust fed by hand through a tube to the intake-valve port. With this arrangement the dust exploded readily and frequently. As many as twelve successive explosions occurred in one cylinder. Finally, with one terrific report the wire-glass plate broke and pieces of it were thrown thirty feet into the air.

It cannot be said that the engine made any prolonged, continuous run, but certainly enough power was developed to turn it over many times. The method of feeding it was not very satisfactory, and if a system of feeding a continuous, measured quan-

tity of dust to the engine could be developed, better operation might be expected. However, the engine used for the experiments, although probably not the right type for a dust engine, gave encouraging results which indicated the possibility of designing an engine to use grain dust as the source of fuel.

AVIATION

Aeroplane Topographic Surveys

Proceedings of the American Society of Civil Engineers.—Harold C. Fiske, the author states that "the object of this paper is to acquaint engineers with a method of making accurate contour maps directly from aerial photographs." The paper is accurate and complete in so far as it refers to the one (and only the one) method which the author has undertaken to present. It happens that, so far as is known to the writer, this method which requires certain patented apparatus, is used in the United States only by the individuals mentioned in the paper. On the other hand, aerial photographs are being used successfully and extensively as part of the process of map making by numerous agencies, governmental and private. The methods used in these cases are ones that do not require a measuring stereoscope nor even, necessarily, a tilt-removing camera, nevertheless the results are, from the engineering standpoint of reliability and economy, quite as satisfactory as those described in the paper. Where the costs and some other features of this special method are satisfactory, the engineer may expect most gratifying results. Whether or not this particular method seems to be applicable in any particular case, there are others from which a choice may be made. So great is the value of the aerial photograph as an adjunct to map making that its use should not be discarded until these other methods have had due consideration.

The sales agents of the various companies engaged in this class of work may be trusted each to set forth in convincing detail the merits of the system used by his firm. What seems to be needed now is not an explanation or a comparison of these different methods but rather a more general statement of the powers and limitations of the aerial photograph. Its use need not be in any sense difficult or intricate, although if the amount of map work to be done is large enough there is ample opportunity to develop skill and to utilize special methods for the elimination or minimizing of the errors inherent in these and all other photographs.

In approaching the subject of the use of aerial photographs the engineer must formulate clearly in his own mind a definite opinion as to what constitutes a map and the purpose which it is to serve. Is it a vehicle to express the skill of the man who made it or a document containing data required by the reader in such form that he may understand it clearly and use it with confidence? Is there

any object in securing data and trying to incorporate it in a map with any higher degree of accuracy than can or will be employed by the user?

Maps have been made and used for many centuries. Until about two hundred years ago they were all pictorial and the artist was the map maker. The user recognized that the hills and streams depicted were substantially the same as those in the vista before him. If this picture guided him to the general vicinity of his destination he relied as a matter of course on his native intelligence to do the rest. The scaling of distances from such a map probably was never considered. In the eighteenth century it was realized that the principles of geometry and trigonometry could be applied to map making. If the distances and angles of a polygon were measured on the ground the mathematically similar figure could be constructed on a much smaller scale on a sheet of paper.

From this point to the modern map progress was rapid. The accumulation of error, due to unskillful work or inaccurate instruments, was promptly recognized and efforts were constantly made to improve both. With better instruments and greater skill larger areas were mapped and in order to keep down the effect of increasing accumulations of diminishing errors the nicest refinements of measuring, recording, and preserving have had to be devised and used. In primary triangulation work distances may be measured with an error of less than 1 in 1,000,000, angles are read to seconds, and the results are engraved on metal plates that will not be distorted by temperature or humidity.

Suppose, however, that the engineer wants to know the distance from Triangulation Station A to Triangulation Station B with an accuracy of 1 in 100,000 and has before him the map on which are shown these two stations. He knows that he cannot scale this distance with anything approaching such accuracy and if the true distance is not printed on the map he must inquire of the map maker, who does not think of scaling the distance from his metal plate but takes it from a tabulation.

Modern maps are possible only because of the ultra-refinements that have been devised by their makers, but it is physically impossible to carry these ultra-refinements through all the processes of map making to the finished product, a printed or lithographed sheet. Maps now have two distinct phases, the mathematical and the pictorial. The mathematical map is a tabulation which, even in high-class work, cannot be shown pictorially. The map user thinks of the tabulation as such, and for him a map is a conventionalized picture on which he sees features of the landscape. On this map he expects to be able to use a scale with confidence in the results but, perhaps outside elaborate city surveys, he will accept an error that is unthinkable to the surveyor. The map maker may

spend days determining whether the distance between Triangulation Stations A and B is 133,256′, or 133,257′. The map user will lay his scale on the map and say that the distance from Station A to Station B is 25.2 miles and will be perfectly satisfied when he finds that he has missed it by only a few hundred feet. When this distance from Station A to Station B is part of a mathematical map, the 1-′ difference may be of vital importance; if it is needed only for the pictorial map, it is of no importance.

For more than four years the writer has been making maps by a method that includes the use of aerial photographs. Between 2,000 and 3,000 sq. miles have been covered and several thousand photographs have been used in the process. All experience to date points clearly to the conclusion that the aerial photograph will never enter the field of the mathematical map. Its use will probably be confined to the preparation of the pictorial map and in order to find its proper place in this field some analysis of such maps is necessary.

This map is a conventionalized picture of several square miles of average open country on which all kinds of natural and artificial features have been vertically projected on a hoizontal plane. It shows all the natural or artificial topographic and such other detail as in any particular case may be called for. The map is to be used by an engineer who has undertaken to lay out and to supervise the construction of an engineering work, such as a canal, a highway, a railroad, a storage reservoir, etc., involving the accurate knowledge of an area of substantial size. With the map before him, the engineer will shape his general ideas, he will scale distances along roads or streams, the areas of fields, lakes, ponds, or those bounded by contours at different elevations.

If this map is to be made by the standard methods which do not include the use of aerial photographs, two distinct steps are required, which have already been designated as the mathematical and pictorial. Under the first comes the establishment of the triangulation or traverse sytsem for the control of the map. Here the permissible limit of error will be 1 in 1,000 to 1 in 100,000, or even less, and the field work is done by the most skillful man available. Such errors are much less than the width of the finest line that will appear on the finished map. Distances can rarely be scaled from a map with such a degree of accuracy, and in any event the user has comparatively little interest in these few accurately determined points.

In the second step, field work is done, frequently, by men less skillful than those required for the first step. A plane-table and field sketching methods are used. Horizontal distances are measured by odometers, pacing, and estimating. Vertical distances are measured by hand-levels, aneroid barometers, and by estimating. The odometer will give a limit of error of 1 in 100, or better; the

pace, an error of 1 in 100, or worse; and no one can with certainty estimate distances to visible objects with an error of only 1 in 100. In contour work the position of an invisible contour is first estimated and then the distance to this invisible point. The result of this combination of estimates is often radically wrong (as will be illustrated by two examples subsequently). In the field work for the pictorial features of the map errors greater than 1 in 100 or the width of the finest line on this map are the rule rather than the exception and the office draftsman in smoothing out contours, bends in roads, etc., introduces still more. In other words, the pictorial data are put on the map with less accuracy than can be employed by the user.

A study of the methods of making ordinary maps will impress on the mind of the engineer three things: First, no matter how accurate may be the control, including the plane-table triangulation or even the road traverses, the engineering detail which most concerns him is that which by former methods is merely sketched in, frequently hurriedly, always (from an engineer's standpoint) inaccurately and usually incompletely; second, and of marked importance, no real check on detail is economically possible by former methods; and third, while the map maker doubtless does well to preserve his truly accurate control on metal sheets, where detail is concerned this is wasted effort. Engineering drawings are customarily made on tracing linen and reproduced on blueprints, and map detail, as engineering data recorded in this manner, need suffer no more than any other.

The engineer does not use standard maps where details are essential but makes his own independent field measurements. This is true in smaller matters, but where large areas are involved the engineer does accept a standard map as an adequate source of technical information. The inaccuracy of such maps is unbelievable. Two examples will illustrate the point.

For a decade or more there has been under consideration by thoroughly competent engineers a project including an area bounded by a contour. This area was planimetered from a standard map and for ten years was accepted as being 66,000 acres. Recently, this area was re-mapped by a method including aerial photographs and when planimetered again was found to be 28,685 acres. Another project involves an initial investment of more than $8,000,000. Certain possibilities were rejected by the engineers primarily because an area bounded by a contour was planimetered on a standard map and found to be "at least 30,000 acres." This area as found from maps prepared with the use of aerial photographs in 9,149 acres. It is believed that all, including those who made the standard map, will agree that the area from the aerial photographic map is not in error by more than one per cent or two per cent at the outside.

This is not a criticism either of the makers of standard maps, of their methods, or of their finished product. Given the same restrictions as to time, cost, and methods no engineer could have made a better map in these cases. Many business men will hesitate a year before they will give a deserving clerk a $100 increase in pay, but will hand over $10,000 at an hour's notice for oil well stock if the salesman is sufficiently persuasive. Engineers and business men sometimes seem to display similar traits.

In standard map making the methods and instruments used are the product of about two centuries of effort by highly scientific men and these have made possible a type of map which for accuracy other than that of detail was never before equalled. In so far as the control or general framework is concerned, it is probable that future improvements can be made only in matters of a technical nature in which engineering profession at large has little interest. In matters of detail present ground methods can produce results that will satisfy the most critical engineer but the cost involved is so high that outside of city surveys and some other analogous special cases these methods cannot be afforded.

In aerial photography, the methods and instruments now used are the product of about seven years of effort by scientific men and many important improvements are still to be hoped for. As matters stand, however, the aerial photograph has already made an important contribution to the science of map making and this perhaps is one of more value to the engineering profession than to any other. The camera cannot supplant the theodolite, the transit, or the spirit level, and probably it will not seriously compete with them; but the topographer with his pace, odometer, and skill acquired with practice cannot compete for a moment with the aerial photograph. He will not cease to exist but when aerial photographs are used he will be required to measure elevations for contours, check scales of photographs and such details on them as may be obscure, too small to be identifiable, concealed by overhanging vegetation, etc.

A map with no control or general framework would be of little value to an engineer. A map having perfect control is of little value to the engineer if the detail is all wrong or is unreliable. A moderate amount of control can be obtained from aerial photographs, sufficient in many cases for the engineer's needs, but their outstanding value is the fact that engineering detail can be taken from them and added to the map maker's control within such limits of time, cost, and reliability as to make the detail on maps true engineering data.

The one item of outstanding importance in making maps by the use of aerial photographs is to get the photographs. One engineering company, known to the writer, bought an airplane, camera, and photographic apparatus complete, and added aviators and

photographers to its engineering staff. The results are understood to have been considered superior for all practical purposes as compared with former ground work. The special equipment and personnel, however, have now been disposed of and in the future aerial photographs will be obtained by contract from companies specializing in such work, and the maps will be made by the engineering company itself.

Several companies take aerial photographs, and most, if not all, of them are also anxious to make the finished map. Whether an engineer should contract for a finished map or make his own from photographs bought from others is a subject still under debate. The writer prefers to make his own maps but recognizes that the other method would free his organizations from a vast amount of detail work. In any event, the engineer should have a fair understanding of the nature and value of the various steps involved.

It is to be understood that by aerial or vertical photographs or prints are meant those taken from an airplane with the axis of the lens vertical and the negative horizontal. Maps can be made from oblique aerial photographs. This method is much in favor in Canada because of special conditions obtaining there in the flat lake region, but there seems to be no reason to expect that this method will be used extensively in the United States. The scale of the photograph depends on the focal length of the lens and the height at which the plane is flying when the exposure is made. Ordinarily, from a height of 5,000′, the scale is about 12″ to one mile. Exposures can be made from lower elevations but most work is done from elevations between 5,000 and 15,000′. Commercial work can be done at 20,000′ and experimental work has been done at 30,000′; but 15,000′ is a good practical limit.

The cameras used are manufactured especially for this purpose and bear about the same relation to the ordinary camera as does a modern surveyor's transit to the old-fashioned compass. High-grade lenses, color filters, and hypersensitive negatives are among the features now standard in this work. The company employing the methods given in the paper uses glass plates for both negatives and positives. Practically all others in private and governmental service use celluloid base negatives and certain specified grades of standard commercial photographic paper for the positives. The reasons for this distinction follow from the fundamental differences in the methods used.

It will be recalled that, in the method described in the paper, a moderate number of carefully measured elevations are required for each positive used. With these available and with the special apparatus mentioned, the print can be completely contoured. The element of critical importance in this method is the fact that when the exposure is made the negative must either be exactly horizontal or, if it is not, must be so rectified that the resulting positive is

the same as if such had been the case. This necessity comes from the fact that the machine which indicates the contours gives points of equal elevation above a reference plane on the ground parallel to the negative at the moment of exposure. If this plane were tilted 1°, these elevations would be in error by ninety-two feet at a distance of one mile from the optical center of the print—an error which is of course far beyond permissible limits.

Emphasis is also laid on the necessity for the use of glass plates because of the danger of warping in other materials due to temperature, humidity, or the creeping of the emulsion. The measuring stereoscope functions with two vertical prints taken close enough together to include the same area in each. The negative is horizontal in each case but the exposures are made so close together that the areas covered by each exposure overlap by fifty per cent or more. It will be realized that objects on the terrain above or below the reference plane have a parallax which is different for the same object in each of the two prints. Also, if the exposure is made from a point 5,000′ or more above, this parallax or difference of parallax is small, particularly for differences of ten or twenty feet corresponding to the contour interval to be determined.

The measuring stereoscope is a device which measures, not simply the parallax of a given elevation, but rather the difference in parallax of the same object on two successive and overlapping prints. This difference is a minute quantity, observed and measured with microscopes and a micrometer and recorded by the machine in terms of elevation. Such being the case, obviously variations in the photographic work, even if they may be microscopic, must be avoided and hence the prominence given to this step by the author and his insistence on the use of glass plates. In other methods where contours are measured on the ground these small distortions of the negatives and prints are much less important and film negatives are sufficiently accurate, as has been demonstrated to the writer's satisfaction, in the work of his office where nearly 13,000 film exposures have been taken.

Turning now to other methods—these do not require the measuring stereoscope and do include the use of film and photographic paper. Contours are determined by measurements made on the ground and all other detail is obtained from the photographs subject to such checks made in the field as may be desired, these checks being made when the contour work is in progress. Errors due to temperature, humidity, film creeping, etc., in the photographic work must be guarded against by skillful and painstaking work in the photographic laboratory. However, if to this step are applied standards customary in other phases of an engineer's routine work there is no difficulty in keeping such errors within manageable limits. Although tilt is always undesirable and the

aviators are especially trained to keep this to a minimum, nevertheless a tilt of 2° does not destroy the usefulness of a photograph, and those having greater tilt are better than none.

The pilot is especially trained to fly at a uniform elevation and to follow a straight course accurately in spite of cross-winds, etc. If the elevation is constant so will also be the scale of the photographs except for variations in the elevation of the terrain below. Due to this factor and to the unavoidable variations in the elevation of the plane, it is best to have the contour party make a stadia determination of the scale of each print used. With a linear scale on each print even subsequent warping of the prints can be compensated. Constant elevation and a straight course also reduce to a minimum a tendency to tilt. These factors and the laboratory conditions are well understood by the firms engaged in this class of work and the engineer who buys his photographs may expect that due effort has been made to minimize such errors, the degree of success achieved perhaps varying with the company that does the work.

When the photographs are received the engineer must constantly bear in mind that they correspond to the plan-table sheets, which, in the standard ground method, have been filled in around some form of control. Where ground sketches are used the location of all detailed information has been determined largely by sighting, pacing, and estimating. The amount and character of the detail shown depend on the judgment and skill of the topographer and his understanding of the instructions under which he is working. Since no two minds are exactly alike, it is certain that he will, in some measure, include unnecessary items or omit some that his superior wants, or both. In addition, there will be errors, usually of omission, due to the fact that important objects may be hidden from his view by some feature of the terrain. In one instance, comparison was possible between the work of an especially skillful and conscientious topographic party and an aerial photograph taken soon after the ground work was completed. In a square less than 2,500′ on a side there were nine reasonably obvious errors by the ground men in the form lines of streams, the correct interpretation of which was the object for which the map was being made.

It is in the delineation of contours that the ground topographer uses the greatest freedom in estimating distance, elevation, and form. He is required to prepare a vertical projection on a horizontal plane of imaginary lines on slopes which he is able to view with his line of sight, making only a small angle with the horizontal. The writer's conclusion is that, outside of city surveys, the most skillful ground topographer is unable to draw contours so accurately but that they can be materially improved by the use of aerial photographs and a stereoscope (not necessarily a measur-

ing stereoscope). Gently sloping terrain would form an exception to any such conclusion.

If, instead of the topographer's plane-table sheet, the engineer has an aerial photograph, he will find there a mechanically complete record of every object visible to the eye of the camera. Some points may be hidden by shadows, overhanging trees, etc., or they may be too small to be identified, but otherwise everything is there and the questions of human judgment and the ability to observe, estimate distances, etc., has been wholly eliminated. In fact, the chief difficulty is that there is too much detail; the engineer probably is not interested in one per cent of what is shown. This is why, in the general case, a map made from aerial photographs, which includes what is of value and omits the remainder, is to be preferred to the photographs themselves. Certain essential objects will be missing, first and foremost of which are contours. In addition it will not be practicable to distinguish monuments marking property lines, telephone and telegraph lines, etc., while such things as church spires, towers, high chimneys, etc., which may be important landmarks will be difficult and sometimes impossible to identify from the photograph alone. Such items, however, can be quickly and definitely located by a field contour party.

The work of the ground topographer is subject to the errors of the instruments used and to the personal equation of the man. The photograph is subject to instrumental errors but not to the human equation. There is a case on record where in an important primary traverse the ground surveyors inadvertently omitted 100 feet and the map was completed without the error being discovered until it was later checked by aerial photography. In the location of detail, which is the operation of prime importance to the engineer, the human equation is the controlling factor. With the aerial photograph this essential phase of the work is done mechanically. If the finished map omits essential features they can be added later, in the great majority of cases, from the photographs on file without going back to the field.

The chief error of the camera parallax is governed by natural laws for which due allowance can be made, and this can in no sense be compared with the vagaries of the human equation. In addition, not only do successive exposures in the same flight overlap but adjacent flights are expected to overlap by fifty per cent. The practical result is that, in the great majority of cases, a given point appears on from two to ten prints. This gives from two to ten independent determinations of any point; it permits the elimination of any photograph made inconsistent with the others by tilt; and the mean of these positions gives a reliable final position for the point. As a matter of fact, few prints have to be eliminated because of tilt.

Having the photographs at hand, the engineer can proceed with the construction of his map along lines closely analogous to those for standard ground surveying. That is, he can start with his known points, traverse roads and railroads, run level lines and then, with the photographs taking the place of the topographer's sketches, add detail from them and contours from ground measurements as may be desired. If this method is followed, the amount of road traverse necessary may be greatly reduced by the use of photographs. Experience shows that a single accurately located highway, for example, is sufficient control from which can be built up the map of an area several miles to each side. The accurate location of single points (selected so that they can be properly identified on the photographs) if spaced one-half mile to one mile apart will do as well as a road traverse. If the method of radial control is used, accurate base lines about eight miles apart are all that are essential, although they are habitually obtained from the ground scale check of individual photographs at much smaller intervals.

There are two ways actually to handle the photographs in this process of map making. The first method is most useful when the scale of the photograph is much larger than that at which the field work is to be done, but it can be used, of course, what ever this relation is. In this method the control is first plotted on plane-table sheets, next, the photographs are properly oriented, and then, by means of a pantograph, roads, railroads, streams, etc., are transferred from the photograph to the field working scale on the plane-table sheets. The topographer takes both this plane-table sheet and the photographs from which it was prepared into the field and there completes the map, using the photographs or measuring on the ground as may be most advantageous. His work is all done on the plane-table sheet and the photographs are used only for reference. This method has been used extensively by the U. S. Geological Survey.

The other method is useful when the photographs have been taken at the same scale as that selected for the final map. It is applicable when the map scale is large enough for photographs at the same scale to show ground features distinctly without the use of reading glasses or other magnification. This is the method used by the writer, the map and photograph scale being 1 to 15,000. In this case, the photographic print itself, used as the plane-table sheet, is taken by the ground topographer into the field. His work consists of checking the scale of the print, drawing contours, and reinforcing such features as may be small, obscure, or hidden by foliage, shadows, etc.

In the first method, contours are located and drawn on the field sheets in the standard way with such assistance as may be obtained from the detailed information on the photograph. In the

second method, the contours are located and drawn on the photographs themselves. Its importance comes from the fact that since the contours appear on the photographs proper they can be examined in the stereoscope and thus give, first, a highly accurate method of determining form and horizontal locations of contours in the field; and, second, a thoroughly convincing office check on these two items. Prior to the advent of the aerial photograph and its stereoscopic use, comparable accuracy in contour location in the field was possible only in expensive city survey methods and even then an office check of this item was physically impossible. Now both a high degree of initial accuracy and the office check are possible at costs which should be less not only than those of city surveys but also than those of the former highly inaccurate method of the sketching board, pace, and aneroid barometer. The stereoscope needed in this process can be made by the average cabinet maker and costs only a few dollars.

There are now several companies engaged in the business of taking vertical aerial photographs and of making maps from them. To such companies engineers must look at least for the first step in the process, that is, the taking of photographs. If the engineering profession at large comes fully to appreciate the value of this method and takes due advantage of it, these companies will be able to continue in business and it will not be long before such photographs will be considered an indispensable feature of a wide variety of engineering studies. Cost, as always, will be an important item and, as in all other business, this depends on the demand. Quantity production is of controlling importance in the aerial photographic side of this work and costs cannot be kept low except where the work is large or several smalled jobs can be completed at the same time and from the same base, thus giving the equivalent of one large work.

Although costs can and should be lowered somewhat by the use of aerial photographs, this is of little importance compared with other advantages to be obtained. The engineer is most interested in the detailed information on maps. Heretofore this has been obtained and recorded by methods which have permitted errors of any kind and magnitude to be included and to pass unnoticed and even unsuspected. By the use of aerial photographs, details are now obtained and recorded by a method that eliminates errors due to the human equation and permits instrumental errors to be minimized to any extent desired. At all stages, including that of the finished product, there is a highly satisfactory check as to the accuracy of the work, particularly as it deals with that vitally important factor, detail.

Arthur P. Davis.—The need of topographic maps as a guide to the planning of extensive engineering works, such as water systems, roads, transmission lines, railroads, and irrigation works,

has been appreciated in recent years to a far greater extent than formerly. Although most engineers now realize the desirability of a general topographic map of a high degree of accuracy as a preliminary to the detail study of engineering works, the time required frequently has prevented the construction of such maps.

To some extent this need is supplied by the federal government in the general topographic map of the country, but this map is by no means complete, less than forty per cent of the country having been covered. From the nature of the case the scale of such maps is so small as to amount, for engineering purposes, only to a reconnaissance survey.

Such maps are usually adequate for determining the drainage area of the catchment basin; for indicating relative altitudes in different parts of the basin; for furnishing a rough guide for the location and selection of reservoir sites; and for indicating the most promising routes for canals or pipe lines, roads and railroads, to be surveyed in greater detail before plans are made. In no case does the general map furnish the final data, except perhaps in the matter of catchment areas, which are useful in computing spillway capacities and in comparing different basins or parts of basins, as to their water yield.

The development of the aeroplane and the adaptation of aerial photography to the construction of topographic maps has brought into a new relation the element of time necessary for the construction of accurate topographic maps on a large scale. The necessary aerial photographs usually are obtainable in a few hours of flight in clear weather, provided the basic location for control has been furnished in advance. Much additional work in the office and laboratory is necessary to make maps from these photographs, but this work is independent of the weather, and a part of its results can be quickly made available provided the maps can be completed from the original photographs.

So many errors are possible in this work that it has been customary to use photographs only for rough guides in the form of mosaic and to re-occupy field points for the purpose of sketching the contours, which are controlled primarily by the preliminary triangulation, and in detail by the photographs themselves. This use of photography is of great assistance, both in the speed and accuracy of the work, and with this method a high grade of topographic maps should be turned out more quickly and cheaply than without it.

The ingenuity of the inventors of the Brock process has accomplished a distinct advance in the production of topographic maps by photography. By clever devices and by re-photographing the plates most of the mechanical errors of the process can be corrected in the manner explained in this interesting paper.

The greatest and most unique advance, however, and the one that most distinguishes this process from others is the translation of the photographs into contours without additional field work through the stereoscopic methods described in the paper. This great improvement, checked as it has been by direct comparison of results, will accelerate the introduction of such methods.

When the advantage and economy, both of money and time, is appreciated, all large enterprises will be examined by the prompt establishment of the tie-points for necessary horizontal and vertical control, and prompt steps will be taken to make comprehensive and accurate photographic maps of the region under study. This will eliminate a vast amount of expense and delay in preliminary surveys and effect still more economies in the elimination of errors of plan and of estimate, due to insufficient preliminary information.

Such preparation should be recognized as essential for the preliminary location of railroads, wagon roads, and transmission lines, and for the location of reservoirs and the determination of their capacities, as well as the canals, tunnels, and pipe lines necessary to utilize the water.

These methods are adaptable to photography of every description. Its greatest advantages obviously lie in regions where other methods are most difficult, as in extremely rough localities or those covered with timber or brush, or those for which the field season is short, as in the more northern regions of America, Europe, and Asia. Vast areas having oil, timber, and power resources are yet to be studied, topographically and geologically, for their development, and such regions offer an almost unlimited opportunity for using accurate mapping methods, which, in turn, will greatly expedite and stimulate their development.

Guggenheim Fund Endows Universities

Aviation, 6 Sept.—Grants aggregating approximately $600,000 to two California educational institutions have been authorized by the trustees of the Daniel Guggenheim Fund for the Promotion of Aeronautics, Inc.

To Leland Stanford University, at Palo Alto, a fund amounting to the income on $300,000 has been awarded for the financing of experiments and study in aviation and aeronautics. Simultaneously, there has been awarded to the California Institute of Technology at Pasadena $200,000 for the immediate erection of a permanent building to be devoted to the study of aeronautics; in addition, grants totaling about $100,000 will be made over a period of ten years for the conduct of study and experiments in this rapidly developing science and art.

In announcing the two gifts, Harry F. Guggenheim, president of the Daniel Guggenheim Fund, stated that they were made not

merely in recognition of the opportunities for study and research which the climatic and other conditions in California made possible, but also as a tribute in recognition of the distinguished work in science and education and the very great contributions to progress made individually by these two educational institutions.

The Daniel Guggenheim Fund for the Promotion of Aeronautics was established by Mr. Daniel Guggenheim last February, with a provision for supplying $2,500,000 as needed by the directors. The fund is unique among the large foundations of the country in that its founder did not contemplate a permanent foundation, but merely a provision for sums which would make possible experiments and developments in the field of aviation during the infancy of this art and science as a civil enterprise.

Importance of Safety

The trustees recently announced that a primary aim of the fund would be the promotion of safety in flying. It is felt that if a fair factor of safety is established in the practice of aviation other measures of progress will follow rapidly. Aviation is now on the verge of developments which will make it clear that not only is flying over great distances mechanically feasible but that the whole art and science can be placed on a basis of safety comparable with traveling by rail, steamship, or automobile.

Dr. R. A. Millikan, president of the California Institute of Technology, has announced in Pasadena, California, that the grant made by the Daniel Guggenheim Fund to the institute would be used as a basis for the establishment of the Daniel Guggenheim Graduate School of Aeronautics at the California Institute of Technology.

There will be constructed immediately an aeronautic building containing a new ten-foot, high speed wind tunnel, the total construction involving an expense of approximately $200,000.

Calif. Inst. of Tech. Proposals

The Daniel Guggenheim Fund has allocated to the institute, in addition to the $200,000 available immediately, the sum of $10,000 annually for ten years. These funds will make possible the following:

"The extension of its theoretical courses in aerodynamics and hydro-dynamics, with the underlying mathematics and mechanics, taught by such men as Professors Harry Bateman, Edward T. Bell, and Paul S. Epstein.

"The initiation of a group of practical courses conducted by the institute's experimental staff in cooperation with the engineering staff of the Douglas Airplane Company, with the aid of the facilities now being provided at the institute combined with those of the Douglas plant.

"The initiation of a comprehensive research program on airplane and engine design, as well as on the theoretical bases of aeronautics.

"The immediate perfection of the new stagger-decalage, tailless airplane recently developed at the institute, primarily by A. A. Merrill—a radical departure from standard aeronautical design, which in recent tests has shown promise of adding greatly to the safety of flying.

"The establishment of a number of research fellowships in aeronautics at the California Institute.

"The planning and manning of the new school so as to include the building and testing, not only of models for wind tunnel work, but also of full-size experimental gliders and power planes for free flight work."

The grant made to Leland Stanford University by the Daniel Guggenheim Fund, represents the income from a capital sum of $300,000, which will be used for the development at Stanford University of the study of and experimentation in aeronautical engineering.

Experimental Work at Stanford

"The grant provides in part a contribution for the development of equipment at Leland Stanford and in part provision for financial support for a period of ten years. In honor of the donor, whose gift has made possible this important development, the Stanford authorities plan to establish the Daniel Guggenheim Experimental Laboratory of Aerodynamics and Aeronautical Engineering.

"The present aerodynamics laboratory in which experiments have been conducted for ten years, established for testing propeller models, will be developed and improved with the addition of equipment for tests to other parts of planes and will be housed in an adequate and commodious brick and concrete structure to take the place of the present temporary wooden building.

"In addition, Stanford University will establish a full course for the training of young men in aerodynamics and aeronautic engineering. This course will be an extension of the present work of the University in aeronautics into a complete and well-rounded six-year course, to be organized at once as a division of the School of Engineering. The first four years will be occupied largely with a broad and general engineering training, while the final two years will be devoted to intensive training in the field of aerodynamics and aeronautical engineering. In this way it is planned to provide young men with the thorough scholastic training necessary to qualify them for effective service in the aircraft industry and air transportation activities, where there is promise of early and large development.

"The Stanford campus is peculiarly suited for the establishment of a school of aeronautics through the large amount of available land for a flying field for experimental use with full-sized planes, and an adequate plot of ground has been held in reserve for this purpose. Furthermore, the location of the campus within a short distance of San Francisco Bay will make possible the development of a seaplane station and landing stage, whenever conditions make that desirable. These developments will place at Stanford facilities for research and practical demonstration in all types and forms of flying craft, both land and marine and in both model and full-scale size.

"The work at Stanford will be organized along three general lines, covering the whole field, and each headed by an expert—(1) aerodynamics, (2) structural design and construction, and (3) laboratory research. The men in charge of the first two divisions are yet to be appointed. The laboratory will be directed by Professor E. P. Lesley, who has, for a decade, been associated with Dr. W. F. Durand in the work of the present laboratory spending a year of that time in the Aerodynamic Laboratory of the National Advisory Committee for Aeronautics at Langley Field, Virginia.

"It is expected that special attention will be given to research and the experimental study of problems connected with aeronautical engineering, and for these lines of work the laboratory with its enlarged facilities will be peculiarly well adapted. Building upon its past work of fourteen important investigations, the reports of which have been published by the National Advisory Committee for Aeronautics, a further series of investigations is now contemplated, dealing among other subjects further with the reaction between the airplane structure and the propeller, its character and amount, and the most effective dispositions for rendering such interference a minimum.

"It is expected that other funds will be found by Leland Stanford University for a limited number of research fellowships, thus furnishing financial aid to specially qualified students while continuing their studies along research and advanced lines."

German Engineer to Visit U. S.

A further announcement is to the effect that Dr. von Karman of Aachen, Germany, one of the foremost mathematical physicists and one of the most outstanding aeronautical engineers of Europe, has accepted the invitation of the Daniel Guggenheim Fund to visit the aeronautical centers of this country in the near future. He will go immediately to Pasadena for the sake of advising the aeronautical staff of the institution, both as to the best type of aeronautical installation and as to the design of new planes already being perfected there.

Aeronautical Clubs

The Daniel Guggenheim Fund for the Promotion of Aeronautics, Inc., wishes to maintain a full list of all flying clubs. Secretaries of such clubs are requested to forward their names and addresses to the Daniel Guggenheim Fund at 598 Madison Ave., New York City.

MISCELLANEOUS

A Next Step in the Pacific

Christian Science Monitor, 4 Sept.—It was an important as well as an interesting contention which was raised the other day at the Williamstown Institute of Politics by Dr. H. Duncan Hall, lecturer on international relations at the University of Sydney, Australia. His thesis is that the machinery for the peaceful settlement of possible disputes in the Pacific basin today is dangerously weak, despite the splendid first steps taken in that direction, in 1922, at the Washington Arms Conference. The four-power pact, then signed (he points out), extends only to "insular possessions and domains," excluding both the American and Asiatic mainlands and, practically, the whole of the Japanese Archipelago—that is, the major part of the area wherein debatable points well might arise.

To this defect in the agreement, which the speaker rightly labeled as "serious," he added two others: "domestic issues," usually so called, should somehow, and at least in part, be brought within the scope of amicable adjudication, and provision should be made for some regularly recurrent conference among the states facing this greatest of the oceans. On these grounds Dr. Hall would have that four-power treaty broadened into a pact embracing Australia, New Zealand, and all other territories properly a part of the basin, with, further, machinery for the submission of all disputes (falling settlement through the customary diplomatic channels, of course) to a commission of inquiry. Finally, he would have the United States, in the near future, take some active lead toward reaching this end.

Granting the soundness both of these premises and conclusion, it remains to be pointed out that the goal which the Sydney professor would have the Pacific world attain is in a fair way of being brought nearer, and very soon. The American Secretary of the Interior, acting under the authority of a congressional joint resolution, has just invited all nations bordering the Pacific, or with landed interest in the region, to send representatives to a conference, at Honolulu, on education, rehabilitation, reclamation and recreation, to be held next April. Then the Pan-Pacific Conference of the League of Nations Societies will meet in the same year, and in 1928 the Conference of the Polynesian Races

and the Pan-Pacific Ethical Congress. In the next twelvemonth, too, though neither specific date nor place of meeting has been announced as yet, will be held the second session of the lately organized Institute of Pacific Relations, to which nine nations are party: Australia, Canada, China, Hawaii, Japan, Korea, New Zealand, the Philippines and the United States. At these gatherings something certainly will be done of that "broadening" sort which Dr. Hall urges as of large and immediate need.

That in this desirable process the United States should lead the way, is entirely appropriate. Saving for amorphous China, Uncle Sam enjoys the very geographical preponderance in the theater under consideration, while in interest, whether commercial or political, he stands unrivaled. Then, too, his tradition clearly points along the path of arbitration and friendliness. Since the time of President Monroe, successive Washington administrations, while declaring that the interests of America necessitated complete detachment from the affairs of Europe, have never ceased to show an active interest in the affairs of Asia.

Almost at the date of Monroe's "doctrine," Edmund Roberts, America's first envoy to the East, was making treaties of peace and good will with Siam and Annam. After him came Caleb Cushing (1844) to negotiate the first treaty between Washington and Peking, and then close followed Commodore Perry's opening of Japan to the Western world. And the program forecast in these earliest moves has been carried through to today with a consistency not always found in American foreign policy.

If the moment be propitious for widening the Pacific treaties, it would seem, as well, that Washington never has stood in a stronger position to initiate and guide the labors that shall result in that achievement.

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NOTES ON INTERNATIONAL AFFAIRS

FROM 3 SEPTEMBER TO 3 OCTOBER

PREPARED BY

PROFESSOR ALLAN WESTCOTT, U. S. NAVAL ACADEMY

GERMANY ENTERS LEAGUE OF NATIONS

GERMANY ADMITTED TO LEAGUE AND COUNCIL.—As a result of careful preparation by the major powers, and after the resignation from the League of Brazil and Spain, the two states who prevented its accomplishment last spring, the admission of Germany to the League of Nations and to a seat on the League Council was carried through at the September Session of the League Assembly without manifest opposition. The Assembly on September 8 voted unanimously in favor of Germany's admission, and on September 10 Dr. Stresemann, the German Foreign Minister, took his seat in the Assembly. In a dramatic scene, Foreign Minister Briand of France made the first speech of welcome.

LOCARNO TREATIES RATIFIED.—The admission of Germany to the League was the last essential preliminary to the ratification of the five Locarno treaties. These consist of the four treaties of arbitration between Germany and her neighbors, France, Belgium, Poland, and Czechoslovakia, and the Rhineland Treaty, creating a neutral zone along the Rhine, and guaranteed by Great Britain and Italy. These were ratified on September 14.

Later, on September 17, Foreign Ministers Briand and Stresemann conferred privately and at length at Thoira, just across the French frontier from Geneva. It was reported that, while their conference covered the whole range of Franco-German interests, it had to do especially with the plan of hastening French evacuation of the Rhineland in exchange for the marketing of German railroad and industrial bonds, now held at Berlin under the Dawes Plan, as a means of providing France with funds.

WORK OF LEAGUE ASSEMBLY.—The seventh session of the League of Nations Assembly opened on September 6 and closed on September 25. Foreign Minister Nintchitch of Jugoslavia was elected president. Aside from its chief accomplishment, the admission of Germany, the Assembly as one of its last acts adopted a slavery convention signed at once by twenty governments in-

cluding Portugal and Abyssinia, whom it most affected. The convention provides for the prevention of slave trade and the abolition of slavery in all forms, together with a pledge not to resort to forced labor save under exceptional circumstances when voluntary labor is unavailable.

It was announced on September 25 that the Foreign Affairs Committee of the Argentine Chamber had approved the proposal of the president that Argentina re-enter the League.

REORGANIZATION OF COUNCIL.—The League Assembly at its September session adopted the measures proposed by its special committee for the reorganization of the League Council. The admission of Germany increased the permanent members of the Council from four to five. To counterbalance this increase of seats for the great powers, the six non-permanent seats were increased to nine, and three of these were made semi-permanent, so that the nations holding them could be re-elected. Since Brazil and Spain for whom two of these semi-permanent seats were planned, had in the meantime signified their intention to drop out of the League, only one nation, Poland, was given a seat of this kind. The other non-permanent members elected were: Chili and Rumania (for three years); Colombia, Holland, and China (for two years); Czechoslovakia, Belgium, and Salvador (for one year).

The Spanish representative absented himself from the League Council session on September 2, and a note from the Spanish government subsequently signified the intention of Spain to withdraw from the League because she was not granted a permanent seat. The note held that insufficient respect had been shown to Spain as the mother country of twenty Spanish-speaking nations, and that the sacrifices involved in withdrawal were preferable to remaining in the League.

WORK TOWARDS ARMS CONFERENCE

NO CONFERENCE LIKELY WITHIN YEAR.—The military, naval, and aerial sub-committees of the Preparatory Commission for the Conference on Limitation of Armament suspended work from September 9 to 27. It was decided that their work had not progressed sufficiently to permit the League Assembly to set a date for a conference prior to its next session a year hence. The sub-committees, however, were to continue their labors and report at a second meeting of the full Preparatory Commission next March or April.

In spite of the slight progress made by the Preparatory Commission, there was strong sentiment among the smaller states at the Assembly in favor of setting a date for a conference within a year; and there was some talk of the possibility of a conference

next spring, the idea being that nations might at least be induced to limit their appropriations so as to keep armaments at approximately their present strength. When the question came before the Assembly on September 24, a resolution was adopted that a conference be convoked before next September unless material difficulties presented, and M. Paul Boncour for France and Lord Robert Cecil for Great Britain pledged their countries to work for the conference in all earnestness warning, however, that it would be fatal to call a conference without complete arrangements that would insure success.

DIFFICULTIES OF DISARMAMENT (By E. L. James in N. Y. *Times,* 10 Sept.).—The American delegates have learned one thing which Washington might profit by realizing to a greater degree than hitherto it has seemed to recognize—namely, that disarmament on the continent of Europe is essentially a political problem and Washington does not loom as the best place to settle Europe's political troubles.

There are two big factors which block disarmament in Europe. One is Russia and the other is the unwillingness, or unreadiness, of France and her allies to reduce radically their military forces until they have what they regard as satisfactory security. If the French expect to get that security from the Locarno Treaty, the records of the experts' meeting indicate no official recognition of that expectation.

In other words, Europe does not wish to adopt any wide limitation program at this time and no one will deny that the work of the experts' committees has been more marked by efforts to prevent disarmament than by efforts to achieve it.

In the minds of all the delegates here, including the Americans, there is no good reason to believe that Europe would disarm any more quickly in Washington than in Geneva. There is a widespread opinion that a general disarmament conference called in Washington would be doomed in advance to lamentable failure.

The reports of the American generals should form interesting reading in Washington, for it will certainly bring home new ideas on disarmament. For example, the reports will show that yesterday the experts' committee adopted a decision which, followed to its logical conclusion, makes the United States the most militaristic nation in the world.

AMERICAN PROPOSALS ADOPTED.—When the military sub-committee met again on September 27, the head of the United States delegation, Mr. Hugh Gibson, made a strong though diplomatically phrased criticism of the tendency of the committee to judge technical questions on their political and economic rather than purely military aspects (i. e., to attempt to judge each question

on the basis of the advantage to the nation represented), and also to limit reports to the opinion favored by the majority. He offered a resolution, which was supported by the British representative and adopted after slight revision, to the effect that the subcommittee should consider only the technical aspects of questions presented, leaving the political and economic aspects to be considered by the Preparatory Commission as a whole. Furthermore, reports were to be so made as to include divergent minority opinions with the arguments therefor and the names of delegations favoring them.

On September 27 Mr. Gibson outlined United States policies as follows:

"My government has consistently been hopeful that our deliberations may result in some concrete basis for accomplishment in the reduction and limitation of armaments. Its hopes for success of our work has been repeatedly expressed by the President and Secretary of State—the latter, it will be recalled, made an important public address on this subject as recently as August 18 in which he reaffirmed our earnest hopes for practical achievement.

"You will recall that during the first plenary session I outlined the general views of the American Government in regard to the problems before the Preparatory Commission. The discussions of our commission and its sub-commission since that time have served to confirm my government in the views I then expressed on its behalf, namely:

"First—That land armaments were more susceptible of limitation by regional agreements.

"Second—That since the Washington naval treaty did not cover all classes of vessels further steps might well be taken to limit competitive building of types of vessels not so covered.

"Third—That success in limitation of armaments is to be achieved by isolation of as many concrete problems as possible and treatment of these in a direct and practical way without waiting for details of a set of abstract principles applicable to all armament problems.

"The American delegation has constantly kept in mind the practical objective for which all are working; namely, actual agreements for limitation of armaments. It has endeavored to face realities and refrain from an exclusively ideal scheme for universal disarmament which existing conditions throughout the world would appear to make most remote in any practical sense. Thus the American delegation has taken the position that limitation to be practicable should be directed toward armaments which are in existence and therefore tangible and limitable.

"The American delegation has consistently discouraged any effort to calculate the potential, economic, financial and industrial resources of one country as against those of another, since it has felt that such elements are not susceptible of limitation and fall outside any practical definition of armaments.

"In regard to limitation of naval armaments the American delegation has attempted to point out that the standard of tonnage by classes—a practical method of comparison and limitation of naval forces which has clearly demonstrated since its acceptance in the Washintgon treaty its utility and convenience as a standard —should be considered in any effort actually to bring about limitation of navies.

"Furthermore, the American delegation has opposed propositions to establish supervision and control of national armaments by an international agency, since it felt that any limitation agreements must rest primarily upon international good faith and respect for treaties.

UNITED STATES AND WORLD COURT

UNITED STATES RESERVATIONS DISCUSSED.—The Conference of Signatories of the Statute of the Permanent Court of International Justice, assembled on September 2 at Geneva to consider the United States reservations, discussed these at length, accepted them all "in principle," and then appointed a committee of fourteen representatives to prepare in detail a formula of acceptance.

COMMITTEE FORMULA APPROVED.—The formula prepared by the committee of fourteen was approved unanimously by the conference on September 23. This formula, to be used by nations in making replies to the United States, was a document of considerable length. In effect it showed eagerness to facilitate the entry of the United States into the World Court and to put that nation on equal terms with major powers in the League. The first four reservations were accepted without qualification. However, it was proposed, in connection with the fourth reservation, that just as the United States reserved the right to withdraw from the League and to give its own interpretation of reservations, so the signatory powers, "acting together and by a two-thirds majority," should have a right to withdraw their consent to the reservations.

The fifth reservation was the chief stumbling block. This provides that "the Court shall not . . . . without the consent of the United States entertain any request for an advisory opinion touching any dispute in which the United States has or claims an interest." It was pointed out by the Canadian delegate that observance of this resolution would involve endless delay, since before rendering any advisory opinion the court would have to refer to the U. S. Government and Senate to see whether an interest was

claimed. It was further questioned whether any one state in the League Council had similar power to veto a request for an opinion. The formula adopted by the committee referred to recent action taken by the Court and expressed the opinion that these changes, and the precedents already established by the Court in disputes involving non-members of the League, would be satisfactory to the United States.

In this country the belief was expressed that entirely unqualified acceptance of the reservations would be necessary to secure American adhesion, and that the formula proposed would not be satisfactory.

FRANCE AND GERMANY

FURTHER EVACUATION OF RHINELAND.—Apparently in accordance with the Franco-German rapprochement at Geneva, France on September 22 began the withdrawal of 7,000 troops from the Rhineland. It was stated that complete evacuation was contemplated, although this could not take place for many months and then only under the most favorable conditions.

Reduction of the French Army was also begun as a part of Premier Poincaré's policy of rigid economy in all government departments. The reduction will bring the officer force from 32,000 to 28,000, or 7,000 less than in 1913.

GREAT BRITAIN

DECLINE OF BRITISH SEA POWER (New York *Times,* September 26.)—England has reached its culminating point as a world power, and may possibly recede from that dominant position in world affairs which it has so long held, according to Dean Ralph Inge, the "gloomy dean," in his book, *England,* one of a series on "The Modern World."

Dean Inge thinks that England and Germany both suffered defeat by the war, and that America was the only victor. He also declares that an English-speaking alliance is an impossibility, and that in the event of England being attacked, the United States would not go to her aid unless the invasion were by a black army. England, friendless, and shorn of her power, with the future dark before her, is the picture drawn by Dean Inge.

There are many reasons for this event, he says, but the main one is the decline of England as a sea power. "English naval supremacy is at an end, and with it the instrument by which we built up and maintained our empire. Naval strength depends mainly on national wealth. We are no longer rich enough to build ships against all possible rivals; and the Americans by insisting on our repayment of the vast debt, incurred for the sake of France, to which we rashly put our names, have secured that we shall remain permanently tributary to themselves, and unable to challenge them on the water.

"Our government had practically to choose between accepting Wilson's 'point' about the freedom of the seas, conceived in an unfriendly spirit to Britain, and agreeing to a numerical equality between the British and American fleets. They wisely accepted the latter, since the unlimited resources of the United States would make effective competition impossible. Our position as a world power is thus permanently altered for the worse.

"There are no occasions for war between the British Empire and the United States, since our government invariably gives way. We sometimes even flatter ourselves that on any great moral issue we are more likely to find America ranged on our side than against us. But no such comforting reflections are possible when we turn to our altered position in regard to our nearest neighbor in Europe.

"We drew the sword primarily for the sake of Belgium, because it has been a fixed principle of British policy that we cannot allow the harbors of Belgium and Holland to pass under the control of a great military power. We have fought several wars, chiefly against France, to prevent this from happening. Now we have been compelled to allow an alliance between France and Belgium, which would place the smaller country at the service of the greater in the event of another war. Thus we have lost a safeguard which we have always deemed primary importance."

British Policy in the Mediterranean.—An article on this subject by Sir Frederick Maurice, in October *Foreign Affairs,* deals chiefly with British policy in Egypt. As regards the Sudan, he feels certain that, although some concessions to Egypt are possible and Egypt is entitled to a guaranteed supply of Nile water, English government and public opinion would never consent to its surrender to Egyptian control.

As regards British forces in Egypt, he believes the Suez Canal could be adequately protected by the fleet and a small garrison along the canal. He writes: The canal is commonly called in the British press "the vital artery of the British Empire." That, like most catch phrases, is an exaggeration. The British Empire existed long before the Suez Canal was constructed, and if the canal were to disappear today the British Empire would not therefore collapse. From a military point of view the position of Great Britain as regards the Suez Canal is not unlike her position in regard to the Dardanelles, when there was danger of a Russian fleet issuing through those straits to make a flank attack upon her communications with the East. It would be a matter of vital importance to Great Britain if in time of war a hostile fleet could come through the Suez Canal and the Red Sea to attack her communications across the Indian Ocean, but that again would be prevented more certainly by a British fleet based upon Malta and the British possession of Perim and Aden at the southern exit of the

Red Sea than by a British garrison in Egypt. If in war with a Mediterranean naval power the canal were to be closed to both belligerents, either by sabotage or by some other means, the loss to Great Britain would not be great, for with modern large and fast steamers troops and stores could be sent to the East by the Cape route more rapidly than they could have been sent by the canal route when de Lesseps had completed his great work. Further, in the event of war against a Mediterranean naval power, the submarine, for the employment of which the indented coasts of that sea are admirably adapted, would almost certainly make traffic between Port Said and Gibraltar so precarious that it would have to be abandoned. For this reason we had during the latter part of the Great War to rely more and more upon the Cape route.

The Suez Canal is not therefore vital to the British Empire, because there is an alternative route to the East which in most circumstances can be more easily secured. The canal is the shortest, cheapest, and most convenient route to the East and the Pacific in time of peace, and until conditions in Egypt are more settled than they are today it may be advisable to keep a small garrison to protect the canal against sabotage. Such a garrison would be much more conveniently placed for this duty elsewhere than in Cairo and Alexandria, and quartered say at Tel-el-Kebir, where it would be equidistant from Port Said and Suez and in easy communication with both, its presence would be unobtrusive. There are thus grounds for negotiation as to the strength and location of the British Garrison, provided that the question of the protection of foreign interests can be settled."

In discussing Great Britain's right to forbid foreign interference in Egypt, Sir Frederick points to the colonial ambitions of Italy, and says that "Were Great Britain to leave Egypt to herself there is little doubt that Italy would not be long in finding a justifiable reason for intervention in a country where there is a large Italian population and extensive Italian business interests." To abandon that work to another power "which has not had the long and costly experience of Egyptian administration acquired by Great Britain would be foolish and not in the interest of the country."

SPAIN

REVOLT CRUSHED.—In early September despatches, the Spanish government asserted that the rebellion organized chiefly by the artillery corps had been put down with only two deaths. Martial law was proclaimed on September 6, and King Alfonso returned by a rapid automobile trip to Madrid.

PLEBISCITE A FARCE.—As was expected and indeed announced before hand by Dictator Primo de Rivera, the plebiscite (Sep-

tember 11-13) on the merits of the present government in Spain resulted favorably to the government. Votes had to be registered openly before local committees picked by the government, which powerfully discouraged adverse votes.

SOUTHEASTERN EUROPE

GREEK REVOLT SUPPRESSED.—On September 10 it was announced that General Kondylis, the recently-established Greek dictator, had put down a revolt of the Republican Guard. This corps had been organized by General Pangalos, but aided Kondylis and demanded a share in the spoils. Colonel Zervas, leader of the Guard, marched his forces towards the government headquarters but was defeated in the streets of Athens with forty killed and about one hundred wounded.

MUSSOLINI AGAIN ATTACKED.—For the third time within a year and at least the fifth since he became dictator, an attempt was made on September 11 against the life of Premier Mussolini. A bomb, thrown by an anarchist at his automobile, bounded from the car and exploded in the road, injuring eight people. The Premier declared that he would protest to France for harboring plotters, whose attempts disturbed Italy.

FRENCH PROTEST TO TURKEY.—On September 2, the French Government sent a protest and demand for indemnity to Turkey because of the arrest of Lieutenant Desmons of the French merchant ship *Lotus*. The *Lotus* sank a Turkish cargo boat outside Turkish waters. After Lieutenant Desmons was induced to come ashore at Constantinople to explain the offense, he was tried and imprisoned.

Later France accepted the Turkish proposal to submit the matter to the World Court.

NORTH AND SOUTH AMERICA

LIBERALS WIN CANADIAN ELECTION.—In the Canadian Parliamentary elections of September 14 the Liberals increased their plurality over other parties, seating 118 members and lacking only five votes of a majority over Conservative and smaller groups combined. During the campaign Mr. Mackenzie King, the Liberal leader and ex-premier, was accused of favoring American annexation. He declared, however, that he stood squarely for Canada's remaining in the empire, but with full power of self-government. The Conservative ministry of Arthur Meighen resigned September 25 in favor of a new cabinet under Mr. King. It was stated that Mr. Vincent Massey of Toronto would be made the first Canadian minister to the United States.

ARMISTICE IN NICARAGUA.—Civil war in Nicaragua was suspended on September 20 by an armistice between the revolutionists of the Liberal party and the *de facto* government of general Chamorro. Disputes are to be arbitrated by Rear Admiral Julian L. Latimer, U. S. N., or officers designated by him.

After the withdrawal of U. S. Marines from Nicaragua, after thirteen years' occupancy, General Chamorro overthrew the Liberal administration and has since been in control. Hostilities against him broke out in August. The U. S. Department of State sent the U. S. S. *Tulsa* to Corinto, the *Galveston* to Bluefields, where sailors and marines were landed, and the *Rochester* to Bragman's Bluff.

FAR EAST

THOMPSON REPORT TO STRESS TRADE AND STRATEGIC VALUE OF PHILIPPINES (New York *Times,* September 25). Baguio, Philippine Islands, September 24.—Colonel Carmi Thompson's report to President Coolidge on Philippine Affairs probably will emphasize the information he has gathered regarding the strategic value of the Philippines to the United States from the viewpoint of international politics and economics.

Americans in high positions in Manila have told Mr. Thompson that the United States should retain sovereignty over the Philippines in order to protect American interests and for the preservation of international peace in the Far East.

According to this view, if we withdrew from these fertile tropical islands, strategically located at the Orient's gateway, we would have to relinquish our position as an Asiatic power. Without the Philippines as a commercial and military base, it is said, we could not enforce the open door policy of equal trade opportunities for all nations in China, could not share the limitless economic opportunities sure to accompany the awakening of the East and could not wage war effectively in the Pacific to protect our interests.

The argument advanced to support this contention is that the Philippines strategically are the only place available to the United States as a base. The Phillippines are part of a group of islands from Japan on the north to Borneo in the south, which form a screen across the Pacific to the coast of Asia, constituting the door to the future possibilities of the Far East. As long as America holds this strategic position, it is argued, she will remain a powerful factor in the Orient's economic and international life.

STRUGGLE FOR WUCHANG.—The conflict between the forces of General Wu Pei-Fu and Cantonese troops advancing into Central China resulted, according to reports at the close of September, in the retreat of Wu's forces, who, however, still held the cities of Wuckang and Hankow on the Yaung-tse River. General Sun Chuan-fan, ruler of the five east central provinces, after some de-

lay allied himself with General Wu, and on September 25 recaptured Nanchang with 5,000 Cantonese. It was reported that the Cantonese had mined the river below Wuchang, and that American and other foreign vessels had been fired on. Several American destroyers were ordered to Hankow.

SHANGHAI COURTS RELINQUISHED TO CHINA.—The agreement between the Consular Corps at Shanghai and the provincial Chinese officials for the return to the Chinese of the Mixed Court was made public on September 27. The Peking régime, although not represented, was informed of the transaction. Foreigners are protected by the continuance of all treaty rights, and the foreign settlements police alone can make arrests within the settlements. The transfer will probably take effect January 1.

Owing to the withdrawal of the Chinese representatives and the absence of a responsible government in China, the Extra-Territoriality Conference has suspended its sessions indefinitely.

BRITISH SAILORS KILLED.—Various reports came from China regarding a conflict early in September between British vessels and Chinese troops on the upper Yang-tse River near Wanhsien. According to the British account, several Chinese soldiers were drowned in an attempt to board a British merchant vessel. Subsequently, General Yang Sen, a follower of Wu Pei-Fu, seized two other vessels of the same company, and trained guns on H. M. S. *Kiawo,* anchored alongside. The *Kiawo* rescued the white officers and crew from the British vessels after fighting in which three British naval officers and four seamen were killed. The British then bombarded the city of Wanhsien.

In the absence of any responsible government in China, the British authorities took no further steps. On the other hand, just before the close of the League Assembly session at Geneva, the Chinese representative, Chu-Chao-hsin, made a violent attack on Great Britain for the bombardment of Wanhsien.

RUSSIA AND GREAT BRITAIN IN CHINA. (From an article by Nicholas Roosevelt in *Foreign Affairs* for October).—In this article Mr. Roosevelt points out that British officials in China have been hampered by a realization that neither the government nor public opinion at home would countenance a policy involving the use of force. Officials themselves realize, however, not only that "the day of the gunboat policy is ended," but that such a policy would not solve present problems.

Referring to the efforts of M. Joffe and later M. Karakhan, Soviet ambassadors at Peking, to stir up anti-foreign and especially anti-British feeling in China, he remarks that it has been easy for them to secure the services of Chinese teachers and stu-

dents for a very small sum to carry on anti-foreign propaganda. They used the strike in Shanghai in May, 1925, and the subsequent shootings in Shanghai and Canton, to further this campaign. The Chinese boycott of British trade, he states, resulted in a drop of fifty per cent in British exports and forty per cent in imports at Hongkong in the third quarter of 1925.

The anti-foreign propaganda stirred up by Russia, however, will ultimately react against the Soviet Government itself. Mr. Roosevelt concludes as follows:

"Russia's great weakness in attempting to carry out her China policy is that her only weapon is propaganda. This weapon, to be sure, she has used with exceptional skill. It is not powerful enough, however, to enable her successfully to combat policies which rest on large trade interests or on strong military power.

"Despite the weakened military prestige of Great Britain in China, she derives great strength from the fact that the Chinese need her products. So long as Britain can prevent other nations from winning her markets in China, the Chinese will be compelled to compromise with her. It is the knowledge of this fact which has made the British always so insistent on cooperation between the foreign powers in their attitude towards China. This has been particularly true in the case of the Hongkong boycott. The British have resented bitterly the fact that America and the other nations refused to join her in boycotting Canton in return for the Hongkong boycott. Not only have they felt that this would have ended the trouble immediately, but they have seen the Japanese, the Scandinavians, and nationals of other countries entering markets in Canton and elsewhere in South China where formerly British trade had been supreme. The British do not want to lose any of this trade permanently, not only on account of its inherent value, but because of its importance in Great Britain's political policy in the Far East.

"Although in no country is the venture of prophecy so hazardous as in China, yet it may be stated that there are in China today two tendencies—first, the gradual weakening of British economic and political supremacy in China, and the concentration of Great Britain's interests west of Singapore; and second, the advance of Russia on Manchuria and North China, strangely parallel to what was taking place prior to the Russo-Japanese War. Both of these tendencies will be hastened or delayed by the development of the so-called nationalist movement in China and by the activities of Japan on the Asiatic mainland.

"Russia still dreams of dominating North China and of ultimately being able to force the hated British out of Asia. Russia's rôle, therefore, is fundamentally an aggressive one. For Great Britain the great problem is to know how to hold what she already has."

BOOK REVIEWS

BOOK DEPARTMENT

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NEW METHODS IN EXTERIOR BALLISTICS. By Forest Ray Moulton, Ph.D., Sc.D., Professor of Astronomy in the University of Chicago, Research Associate of the Carnegie Institution of Washington (1908-22), formerly Lieutenant Colonel Ordnance Reserve Corps, U. S. Army. The University of Chicago Press. $4.00.

Interest in exterior ballistics dates back to Galileo and Newton and includes throughout the time up to the present, names prominent in mathematical and physical research. Galileo demonstrated the parabolic shape of the trajectory *in vacuo,* and Newton was the first to take into account the resistance of the air on a basis of experiments with falling spheres. From time to time the art of gunnery has made greater and greater demands upon the science of ballistics and many and strenuous efforts have been put forth to meet these increasing demands. Siacci's methods as improved by Colonel Ingalls were considered adequate in this country up to the time of the World War. Then, however, the increased ranges of heavy artillery, the stringent requirements of barrage fire without observation, and the introduction of anti-aircraft guns showed that these methods were inadequate. New methods were accordingly developed by the ballistic section of the Army Ordnance Department under Professor Moulton who was personally responsible for the greater part of the revision.

Professor Moulton enjoys international preëminence for his fundamental research in celestial mechanics and mathematics and is one of those exceedingly rare individuals who, while capable of reaching the greatest heights of intellectual achievement, are yet able to keep their feet firmly planted on the solid ground of practice and experience. His interest in exterior ballistics thus commenced has been continued up to the present time in connection with the instruction of army and naval officers sent to study under him at Chicago. Many of the results contained in the

book have, of course, been published previously, having in fact been used during the World War. There are, however, many new important results given.

The book is not of an elementary character and, in many places, would be extremely difficult reading for one who has not been sufficiently grounded in the methods and notations of higher analysis. The results obtained are of a fundamental character and give a rigorous justification of the methods advanced. Throughout, it is characterized by elegance of treatment and of choice of notation. Of necessity, assumptions as to physical laws are made due to our ignorance of the true relations. However, the theory is constantly checked against such experience as is available. The assumptions made are set forth explicitly and the consequences of their possible inadequacy are discussed. No tables for use in actual computation are given but numerical illustrations are frequent and the needs of the computer have been kept well in mind.

The typography and the illustrations are excellent. Only a few mis-prints have been observed and these few are quite obvious and unimportant.

There are six chapters. In Chapter I are deduced the differential equations for the motion of the projectile considered as a material particle. It is shown that contrary to what has been often supposed the effects of the moon and sun on even the longest trajectories of the present day are negligible.

In Chapter II are treated the attraction of gravity and the nature of the resistance function. It is shown that a conical-headed projectile will probably experience less resistance by the air than one with the classical ogival head. This conclusion seems to be borne out by experiment. In this chapter there is also developed a new and more rigorous analysis of resistance function firings. It has recently been adopted at the naval proving ground. This method not only avoids the theoretical errors committed heretofore but furnishes more data from each firing.

In Chapter III is expounded the numerical solution of differential equations, which is illustrated by its use in solving a two body problem. Its application to computation of trajectories is briefly outlined.

In Chapter IV is taken up the theory of differential variations, or in other words, the effects on "normal" trajectories of relatively small abnormalities. The method here developed is characterized by its generality. Unlike Bliss's system of adjoint equations (which is also described) Moulton's method gives the coördinates and components of velocity throughout the perturbed trajectory. The chapter includes a discussion of weighting factors which although used in the Army have not as yet been introduced into

naval practice. A method is developed for the construction of general ballistic tables with a minimum bulk which will yet give not only the coördinates and components of velocity for primary trajectories but also for secondary ones, and weighting factors as well.

Chapter V is devoted to establishing the validity of the method of numerical integration. It includes the proof of Picard's process, the extension of Picard's interval, and a new proof of the validity of the Cauchy-Lipschitz process by showing its relations to the former proof. The effects of approximate quadratures are considered and it is shown that the method may be made as precise as desirable. The solution is shown to have properties of continuity and differentiability with respect to the independent variable and the initial conditions.

The last chapter of the book, Chapter VI, includes what will probably be of greatest interest to those who are already familiar with the subject. It treats the dynamics of the projectile as a rotating rigid body of finite dimensions. The equations of motion are derived by a direct method, thus avoiding any possibility of erroneous definition. The problem treated in this chapter is of extraordinary difficulty, a fact which may not be fully appreciated even by experienced mathematicians who have not encountered the subtle possibilities of error latent in its final development. The method of attack adopted is to treat first a simplified case and then on this as a basis to build the additional complications necessary to secure harmony with observed results. The experimental difficulties involved in the attack on this problem have been so great that it was unavoidable to make assumptions as to the physical relations involved. The justification of these assumptions rests on the double ground of making the problem mathematically tractable and of conforming closely to experimental results. Undamped motion is first treated and the resulting types of motion classified and discussed. So far the treatment is similar to that of the classical top problem. Expressions are obtained for the period of the yaw and the precession during this period. A criterion of stability is deduced and there is enunciated the important principle of dynamic similarity between projectiles of different sizes but the same shape. Based on the criterion of stability, a discussion is made of the effects of various modifications of projectiles and the conditions under which they are fired. The effects of damping are next considered. The damping of the spin is treated first, and then the effects of a damping force opposing the oscillations of the projectile. Both types of damping are treated in terms of the effects on the maximum and minimum yaw. Here, as always, close harmony with physical observations is obtained. Finally the differential equations for motion on a curved trajectory are de-

veloped and the effects of damping forces, when the projectile moves in a curved trajectory, are considered. This discussion leads to an explanation of the reasons for a projectile maintaining its axis of spin nearly in the line of the tangent to its trajectory. Professor Moulton has demonstrated the existence of a steady-state solution which gives the first adequate analytic explanation of drift. In other words it is shown that the projectile may attain and retain a position in which its nose is a little below and a little to the right of the tangent to the trajectory, thus giving rise to a transverse component of force tending to cause drift. In conclusion Professor Moulton outlines the ways in which his theory can be modified to take account of advancing knowledge of the physical relations as it may be acquired from time to time by experiment.

L. W.

SHIP MODEL MAKING. By Captain E. Armitage McCann. Norman W. Henley Publishing Company, New York. $2.50.

REVIEWED BY REAR ADMIRAL ELLIOT SNOW (CC), U. S. NAVY

Ship Model Making, which has recently made its appearance, has for its object the interest of beginners in the fascinating pastime of making ship models. To this end the author describes and gives the details of two models which are "a happy medium between purely decorative craft and exact scale models." The craft with which the book deals have, according to the author, been designed from original matter instead of being copied from other models "of vessels that one time were in service." Because of the author's object which has been realized in an interesting way the models are "rather different from most of those now seen." Captain McCann calls them "sketch-models" a term which is fairly descriptive.

Two models only have been dealt with in the book—A Barbary pirate felucca which is based largely upon information obtained from models collected by Peter the Great of Russia, and a Spanish galleon. The description and plans of these two vessels were originally written for the *Popular Science Monthly* and appeared in recent issues of that magazine.

Throughout the text are some eighty-three drawings and sketches of details. For instance, quarter lanterns, oars, cannons and their carriages, fittings for spars, gun port shutters and a good deal of what is termed "ginger bread" work—decorative features. In addition, working plans for the larger parts of both vessels are contained, on separate sheets, in a pocket inside the back cover. Nearly every sketch is drawn to full size; for parts not so drawn, or if the model maker desires to change the scale, the author shows how the drawings and sketches may be proportionately

enlarged or reduced. The felucca, if built to a scale of about one eighth of an inch to the foot, will be about twenty inches long, three inches in width (of beam) and seventeen inches from keel to top of masthead. The galleon on approximately the same scale will be thirty inches long, five inches beam and thirty inches in height. The plans and descriptions are easy for an amateur to follow.

For each craft there is included a list of the tools needed to make them, and complete bills of all materials required in their make-up. The method of building or assembling the parts and numerous details of accessories and rigging all of which are so necessary, even in "sketch-models," are given.

The chapters on painting, and decorating and the colored frontispiece, will enable any one who makes the model of these two curious looking vessels—one a treasurer carrier, the other a marauder, to color their hulls, sails and sail devices, flags and banners in the brilliant and variegated hues used on real similar craft in their heyday.

With some instructions as to finishing touches, the book ends appropriately thus "Just a bit of this and a bit of that, a little patience and perseverance, handy fingers and good taste and a [tiny] ship is built which will give lasting joy and be the admiration of your friends."

Though the models with which the book deals, do not represent any particular craft which centuries ago sailed the Mediterranean or other seas, this book for beginners makes a very acceptable addition to the growing literature of its kind.

THE DARDANELLES EXPEDITION. By Captain W. D. Puleston, U. S. Navy. U. S. Naval Institute. $2.50.

(See Secretary's Notes, page 2408, this issue.)

SECRETARY'S NOTES

Circulation

The circulation of the PROCEEDINGS since January 1926, has increased 595 copies; the membership of the Institute since January, 1926, has increased 328 members.

Proposed Changes in Proceedings

Last month, in these pages, the Secretary published practically all of the replies received by the Institute with regard to the proposed changes in the PROCEEDINGS, and it was evident that there was considerable apprehension upon the part of a few members that the Board of Control proposed making radical changes, involving the Mission of the Institute. The whole question was set forth in the July issue of the PROCEEDINGS, with a view to getting the reaction of the membership as a whole, in order to determine in what way the Board of Control could better the PROCEEDINGS in carrying out its Mission. The response, compared to the great number of members, was small; and, while the Board of Control is not yet ready to make any definite announcement, the Secretary feels justified in stating that no change will be made in the name of the magazine, the Academy seal will not be removed, and neither will the front cover contain an illustration; both the outside and inside contents pages will be retained. At this time, it appears from the replies received that the members would like to see such departments in the PROCEEDINGS as "Discussions", "Professional Notes", "Notes on International Affairs", and "Book Reviews", published in larger type, and, if it could be done without increasing the cost, to have the same size type as in the main body of the PROCEEDINGS. This would make it easier on the eyes. There has also appeared a tendency toward using a duller paper, as complaints have been received that reading the thin smooth glazed paper under a light is very trying on the eyes. It is hoped that a definite announcement will appear in these pages in the December issue, as to what action the Board

of Control will take on the latter changes. However, whatever changes will be made will begin with the January 1926 issue, in case it is decided to have a slightly larger page, which may be necessary to meet the additional expense incurred by permanently adopting the large size type. It will be noted that in the October number, as well as this number, the departments appeared in 10 point type, the same size as has been employed for the main body of the PROCEEDINGS, except that the type for the departments has been set solid, instead of leaded.

There will be no change in the character of the articles and no such change was contemplated although the original announcement in July might be so construed.

"The Dardanelles Expedition"

Copies of *The Dardanelles Expedition* have been submitted to the principal naval and military commanders, who took part in that campaign, for their inspection and comment. Acknowledgments have been received from the French, most of the British, the Australians, the German, and the Turkish participants. Some of these officers have gone carefully through the book and pronounced it accurate in the narrative with one or two minor exceptions, which do not affect the accuracy of the book as a whole. In the main they agree with the judgments and conclusions of the book, although, naturally there is some divergence of opinion. Others have not completed their inspection but will give their opinions of the book later. No important new facts were brought out, and nearly all commentators agree that though extremely concise, nothing essential to a complete understanding of the expedition has been omitted. The Secretary therefore hopes this book will become a standard condensed study on this subject, comprehensive enough for the busy reader interested only in its salient features, and a valuable guide to those who have further time to read the details of this campaign in other books. If the book is revised, full advantage will be taken of the comments of the participants in this memorable struggle, who have been frank and dispassionate in their remarks. The only unfavorable book review is from the London *Times,* who thinks the author is ignorant of the British form of government and too critical of its conduct of the campaign. The reader can judge between the author and reviewer on this question. And as the

British form of government is not entirely unknown in this country, Institute readers are qualified to make their own decisions. Other book reviews have been uniformly favorable. Extracts follow:

It is probably the most accurate and concise account of the naval attacks, of the effect of naval fire on forts and seacoast artillery fire on ships, and of the campaign as a whole. This study should be valuable to any one interested professionally in combined military-naval operations.

—*Coast Artillery Journal*

Many are the books which have been written for the purpose of embodying the lessons of the World War, and doubtless, there will be many more. Occasionally, in this ever-accumulating literature, there stands out a work which, because of its clarity, forcefulness and the analytical power displayed, carries particular value. In such a class belongs *The Dardanelles Expedition*—a condensed but complete analysis of that ill-fated venture, written by Captain W. D. Puleston, U. S. N.

So far as the civilian reader is concerned, the fault of much of the war literature is its bulkiness and over-elaboration of detail; but to any one who is looking for a concise, clear and thoroughly understandable story of the complicated Dardanelles expedition, we heartily commend this book.

—*Scientific American*

Each phase of the many varied employments of forces has been treated in full detail. In fact the book gives an object lesson in modern naval and military tactics. These are graphically described, and yet with a truly laudable avoidance of length. As he himself has stated on his title page, his book is a "condensed study." The general reader need not be afraid of being inmeshed in a mass of technicalities. The situations are reviewed one by one, and the stories of the operations well and clearly told.

—Boston *Transcript*

An excellent brief study from the naval viewpoint.—*Foreign Affairs*

The services have been looking for a publication from the pen of an unbiased writer on the details of the amphibious operation at the Dardanelles. Captain Puleston has prepared in his book a connected story of the inception of the expedition and strategic reasons therefor, the naval attack, the land operations and the withdrawals, on all of which he makes pertinent comments. The operation as described is easily followed by means of the numerous maps which were prepared by Lieutenant Colonel G. L. McEntee, General Staff, U. S. A., and are a complete story in themselves. . . . .

The book is recommended unhesitatingly for study by all army officers, and especially by infantrymen, who, in event of war, may be called to land on a defended shore, or be required to protect our own shore.

—*Infantry Journal*

Captain Puleston's book on the Dardanelles campaign does not add to our knowledge of the subject, as it is simply a digest of the report of the Dardanelles Commission material, the official histories, English and Australian, and the narratives of such writers as General Callwell. It should be added that although Captain Puleston's book is an abridged edition of more detailed (and more valuable) histories of the campaign, he never quotes the authorities to whom he owes so much. But although he has nothing new to say, his book is interesting on account of its tendencies and criticisms. Read in conjunction with Captain Frothingham's history of the naval war—which professed to have an official coloring—Captain Puleston's narrative gives us a very good notion of the manner in which the campaigns of the war are to be presented to the American public. The accounts—official and semi-official—are apparently to be short and easy to read and highly critical. Captain Puleston starts from the assumption that, in war, the British Government can do no right; but he is never sufficiently clear-headed to distinguish what he considers to be the sins of the British Government as a whole from what he considers to be the sins of Mr. Churchill in particular. As there is nothing in Captain Puleston's book which is of any interest to a British reader except his indictment of Mr. Churchill and the British Government, his accusations are worth examining rather closely. . . . . The purpose of this rather long discussion is to show that owing to his ignorance of British administration, Captain Puleston's criticism is rather wide of the mark.

—London *Times* Supplement, September 16, 1926

The "Constitution-Guerriere" and Other Pictures

Inquiries have been made by members as to where they might obtain copies of the colored picture of the *Constitution-Guerriere* Engagement, which appeared as the frontispiece of the October, 1925, PROCEEDINGS. Four original paintings by Thomas Birch, showing the different phases of this engagement, hang in the office of the Commandant of Midshipmen, Bancroft Hall. The October, 1925 frontispiece showed one of these. The four paintings are designated, for convenience, as follows:

No. 1—The Engagement
No. 2—The Battle
No. 3—Falling Astern
No. 4—Total Wreck

Anyone wishing a colored photograph of the above may obtain either one copy or a set of four, framed or unframed, postpaid, by sending a check or money order to E. J. Colleran, 21 Dean Street, Annapolis, Maryland.

The colored photographic copies are furnished in oil colors (with burnished gold frames in case they are desired).

Size 11 x 14

Framed —Set of Four,	$15.00
Framed —Single Picture,	4.00
Unframed—Set of Four,	10.00
Unframed—Single Picture,	2.75

The following additional pictures, copied from original paintings, hand colored in oil, framed in burnished gold, size 12 x 15, may be obtained from the same address:

Constitution at Sea
Constitution the Chase
Old Sailors Spinning Yarns
John Paul Jones
George Washington
Yacht America
Return of the Mayflower
The Chapel

Price each: $5.00 postpaid.
Money refunded if in any way unsatisfactory.

Membership: New members not previously published:

Burkhart, J. E., Mr.
Gano, R. A., Ensign, U.S.N.
Gibbs, R. H., Ensign, U.S.N.
Herrmann, E. E., Lieut., U.S.N.
King, J. W., Lieut., U.S.N.
May, E. F., Ensign, U.S.N.
Neyman, C. A., Lieut. Comdr. (ChC), U.S.N.
Old, E. H. H., Comdr. (MC), U.S.N.
Pratt, C. F., Ensign, U.S.N.
Whiteford, C. A., Lieut., U.S.N.

SPECIAL NOTICE

NAVAL INSTITUTE PRIZE ESSAY, 1927

A prize of two hundred dollars with a gold medal, and a life membership in the Institute (unless the author is already a life member, in which case he will receive the commuted value thereof), is offered by the Naval Institute for the best essay submitted on any subject pertaining to the naval profession.

The following rules will govern this competition:

1. The award of the prize to be made by the Board of Control, voting by ballot and without knowledge of the names of the competitors.

2. Each competitor to send his essay to the Secretary-Treasurer in a sealed envelope marked "Prize Essay Contest." The name of the writer shall not appear on the essay, but instead thereof a motto. Accompanying the essay a separate sealed envelope will be sent to the Secretary-Treasurer, with the motto on the outside and the writer's name and motto inside. This envelope will not be opened until after the decision of the board. Essays must be received on or before January 1, 1927.

3. In addition to the "Naval Institute Prize," one or more essays may receive "Honorable Mention," if of sufficient merit to justify that award; or, in the event that no essay is adjudged of sufficient merit to receive the "Prize," the best essay submitted may receive "Honorable Mention" in lieu thereof.

4. In case one or more essays receive "Honorable Mention" the writers thereof will each receive a prize, the amount of such awards to be decided by the Board of Control in each case.

5. Announcement of awards will be made as soon as practicable after January 1, 1927.

6. Essays awarded the "Naval Institute Prize" or "Honorable Mention" will be published in the NAVAL INSTITUTE PROCEEDINGS as soon as practicable. Essays not awarded a prize may be published at the discretion of the Board of Control, and the writers of such articles shall be compensated at the established rate for articles not submitted in competition.

7. Articles shall be limited to twenty (20) printed pages in the PROCEEDINGS (approximately 8,000 words), but shorter articles will receive equal consideration.

8. In the event of the prize being awarded to the winner of a previous year, a gold clasp suitably engraved will be given in lieu of the medal.

9. All essays must be typewritten, and submitted in duplicate.

H. A. BALDRIDGE,
Captain, U. S. N., Secretary-Treasurer.

INSTRUCTIONS FOR CONTRIBUTORS AND MEMBERS

Articles The Institute desires articles of interest to all branches of the service, including the reserve force. Non-members as well as members may submit articles, and authors receive due compensation for articles published. **Compact, well digested articles are more likely to be accepted for early publication.** In accepting articles for publication, the Institute reserves the right to have such articles revised or rearranged, where necessary, in order to bring them up to the required standard of articles published in the PROCEEDINGS—the cost, if any, to be deducted from the compensation due the author.

Contributors are requested to observe the following special instructions in preparing articles for the PROCEEDINGS:

(a) In writing names of ships put only the initial letters in capitals and underscore the names. The underscoring signifies to the printer that the word is to be in italics. The same applies to names of publications. Foreign words not anglicized should also be italicized.

(b) In preparing tables and computations employing fractions, subnumbers, etc., do by hand that part which cannot be made perfectly clear by the typewriter.

(c) In typing the script use double space between lines.

(d) When a quotation is included in an article the editor should be assured by appropriate notation that the writer has carefully verified the quotation as presented.

Reprints Authors of published articles are entitled to twenty gratis copies of reprints.

Discussions Discussion of articles published in the PROCEEDINGS is cordially invited. Discussions accepted for publication are paid for at approximately one-half the rate for original articles.

Book Reviews As soon as practicable after the publication of books on subjects of professional interest, the Institute aims to publish authoritative reviews of them, reviewers being remunerated.

Address of Members In the past, many errors have resulted from the habit of changing an officer's address as soon as his transfer orders are published in the papers. No change will be made in the future except upon receipt of notification by the member concerned. Reliance upon the former method may, in extreme cases, mean a delay of almost four months. To insure the prompt delivery of the PROCEEDINGS and other communications from the U. S. Naval Institute, it is essential that members and subscribers *notify the Secretary-Treasurer without delay of every change of address.* No responsibility can be accepted for failure to receive the PROCEEDINGS, where members fail to comply with this rule. Changes of address should reach the Institute by the 20th of the month, to be effective for the issue of the PROCEEDINGS of the following month.

PUBLICATIONS
U.S. NAVAL INSTITUTE

Robison's Manual of
Radio Telegraphy and Telephony
6th Edition

This book, written for the U. S. Navy, first appeared in 1907, the author being Lieutenant (now Admiral in command of the U. S. Fleet) S. S. Robison, U. S. Navy. This edition has been revised and brought up to date by Commander S. C. Hooper, U. S. Navy, Radio officer of the U. S. Fleet, during the past year. A review of this book appeared in the December issue of QST (the official magazine of the American Radio Relay League of Hartford, Conn.), in which it was stated this is perhaps

"The Best Radio Book That Ever Came to This Desk"

The review was as follows:

"The famous 'manual' has, in its 6th edition, risen to entirely new heights. This last edition ranks with the very best of all published radio matter and adds to its usefulness the excellent printing and binding that has marked the earlier issues.

Never have we seen a book that so well followed out the plan of starting with simple theory but always keeping in mind that the reader was interested in the application of the theory, and cared nothing about the theory itself. Therefore the text progresses rapidly to the actual apparatus and discusses the modern types clearly, rapidly and usefully.

This book is so universal that it deserves unusual treatment and shall have it—here are the chapter headings in full.

1—General Theory
2—Elementary theory of electricity
3—A.C. Theory
4—A.C. Theory applied to radio
5—Damped oscillations
6—Wave propagation
7—Radio Instruments
8—Radio Transmission
9—Radio Reception
10—Theory of vacuum tubes
11—Vacuum-tube transmitters

Part 2—Practical application of apparatus and measurements.
1—Practical application of apparatus
2—Radio measurements

Part 3—Useful Information
1—Tables and formulas
2—Mathematics (Arithmetic, Algebra, Geometry, Trigonometry)
3—Radio Laws
4—Miscellaneous

Part 4—Index

That is a tremendous territory to cover in a single volume, and it takes almost 900 pages to do the job. However, the job is done and the result is a book that is not only worth $8, which it costs, but is perhaps the best radio book that ever came to this desk."

PRICE, $8.00 POSTPAID

Send checks or money orders to Secretary-Treasurer,
U. S. NAVAL INSTITUTE, ANNAPOLIS, MARYLAND, U. S. A.

Special Offer: Send $2.00 additional and the "Storage Battery Manual, Including Principles of Storage Battery and Design, 1920," by Lieut.-Comdr. L. C. Dunn, U. S. Navy, will be sent postpaid. This book of 391 pages recently sold for $7.00.